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Animal Health Research—Gift of £20,000 by Mr. F. D. McMaster.

Since the last issue of this *Journal* appeared Mr. F. D. McMaster, of "Dalkeith," New South Wales, has made the Council the magnificent gift of £20,000 to provide for the erection of a laboratory for the investigation of problems connected with animal health.

In making the gift Mr. McMaster accepted, in a most generous and public-spirited way, a challenge by the Prime Minister of the day (the Right Hon. S. M. Bruce, P.C.) who, speaking at a luncheon of the Sheep Breeders' Association of New South Wales, drew attention to the serious economic position into which the Australian wool industry was falling. The Prime Minister indicated further that, in order to meet the ever-increasing competition it was experiencing from other countries as well as from artificial fibres, the industry would need to make the very fullest use of scientific methods and the results of scientific research. He went on to say that while the Government was prepared to go a long way, through the Council for Scientific and Industrial Research, to meet the cost of the needed research work, it must be recognized that the Government could not do everything, and under the circumstances it invited the industry or any individual pastoralist to assist in the work by providing the necessary laboratory buildings. Within a few weeks this challenge was taken up by Mr. McMaster. The interesting deed of gift in which he subsequently expressed his wishes and intentions is reproduced elsewhere. (See Plate 2).

Some progress in connexion with the plans and organization of the laboratory has already been made. It will be known as "The F. D. McMaster Animal Health Laboratory," and the work carried out within its walls will relate mainly to problems of the sheep industry. The authorities of the University of Sydney have agreed to provide a site for the building within the University grounds, and sketch plans are now under consideration for its erection alongside the existing Veterinary Department of the University facing Parramatta-road.

The problems to be investigated will relate in the main to the health of sheep, including bacteriological and pathological problems such as caseous lymphadenitis and braxy disease, and also the large group of parasitological troubles due to stomach worms, lung worms, &c.

The New South Wales Department of Agriculture and the Graziers' Association of New South Wales have been approached in addition to the University, and arrangements are in train for giving all these organizations a voice in determining the programme of the laboratory. It is hoped in this way to ensure that the work of the laboratory will be intimately associated, not only with investigations conducted in other laboratories, but also with the practical side of the industry as viewed by the graziers themselves.

The association of the name of Mr. F. D. McMaster with a laboratory which is to concentrate primarily on problems relating to sheep is particularly appropriate. For many years "Dalkeith" station, where the famous stud of that name is located, has been owned by the McMaster family. It is situated on the rising country overlooking the township of Cassilis, and is 27½ miles west of the Merriwa railway and 50 miles north of Mudgee (N.S.W.). It comprises 36,000 acres of hilly basaltic black soil country, including 5,000 acres of black soil plains on the Talbragar River. "Dalkeith" was originally granted to Robert Scott, who, when the gold rush set in, was deserted by his shepherds and sold the land to the Honorable William Busby. It was purchased by the present owner's father in 1890, and sold by him to his son (Mr. F. D. McMaster) in 1899.

The "Dalkeith" stud has reached a high standard, having bred two grand champions of the Sydney Show and several reserve grand champions. It produced the ram "David," which sold for 5,000 guineas, with the right to send 50 ewes for service after sale (worth another £1,000). This constitutes a world's record price for a sheep.

Mr. F. D. McMaster himself is the third generation of McMasters in the pastoral business. His father came to Australia with his parents at the age of fourteen, and immediately started on the land. His grandparents came from Morven, Argyllshire, in Scotland. Besides "Dalkeith," his father owned "Binnia Downs," near Coolah, which is now in the possession of his brother, and which has been in the family for about 90 years; "Pollybrewon," near Walgett; "Bundella," near Quirindi; and "Old Coolah," near Coolah, now called "Oban."

Mr. F. D. McMaster was educated at the Sydney Grammar School, is a J.P., a Commissioner for Affidavits of New South Wales, a director of the Commonwealth Wool and Produce Company (which his father helped to found), a director and trustee of the New South Wales Lawn Tennis Association, a past chairman and still a member of the Merriwa P.P. Board, member of the council of the Royal Agricultural Society of New South Wales, member of the councils of the Royal Empire Society and of St. Andrew's College, an honorary life member of the English Speaking Union, and a member of the New South Wales State Committee of the Council for Scientific and Industrial Research.

Standardization and Simplification.

Industrial Efficiency Essential to Australian Development.

*By W. R. Hebblewhite, B.E., A.M.I.E. Aust., General Secretary, and S. J. McAuliffe, A.M.I.Mech.E., A.M.I.E. Aust., Chief of Simplified Practice Division of the Standards Association of Australia.**

The Australian Commonwealth Engineering Standards Association and the Australian Commonwealth Association of Simplified Practice have recently been re-organized under the title of the Standards Association of Australia. The Commonwealth Government has decided that the Council for Scientific and Industrial Research shall act as the liaison between the Government and the new Association. This action was taken largely as a result of the Report of the British Economic Mission which visited Australia in 1928. The following article explains the advantages and benefits of standardization and simplification and outlines the organization and policy of the new Association.—[ED.]

1. The Malady and its Diagnosis.

"Efficiency in production may in many respects be regarded as the ultimate test of the soundness of a system of industrial organization. Upon the ability to turn out goods with the minimum expenditure of energy rests the survival, not only of a given business unit, but also of the type of economic organization within which an individual business unit functions. In the long run, business profits can be maintained only upon the basis of methods of production which are at least as efficient as those elsewhere employed. Likewise, low prices cannot be maintained unless they reflect low costs; and low costs, in their pecuniary expression, are incompatible with a relatively high expenditure of production energy."†

In these days when Australia is facing an economic crisis, there is heard on all sides the plea for efficiency of production. Meeting in competition countries which, with the aid of a large home market, have developed the cult of efficiency to a remarkable degree, Australia finds her industries, primary and secondary, beginning to languish. Her great primary industries, with prices falling in the world's markets and profits diminishing in consequence, look hopefully to science which brings the fruits of research to bear upon the problem of eliminating the waste attendant upon the ravages of drought, pest, and disease. In the secondary industries, the employer seeks tariff protection under which to shelter from overseas competitions, the employee claims less arduous hours of toil with a high standard of living, and the unemployed demands the creation of new jobs to provide him with the wherewithal to live. Each of these pleas is fairly generally regarded as intrinsically reasonable, but the inescapable truth based on economic laws is that each can be won only to the degree to which it is earned, and the capacity to earn

* In preparing this article the authors have drawn largely on a paper entitled "Standardization and Simplification: An Approach to Industrial Efficiency," read by Mr. G. Lightfoot, M.A., before the Australasian Association for the Advancement of Science, Adelaide, 1924.

† *Mergers in Industry.* A Publication of the National Industrial Conference Board, Inc., New York.

is in terms of increased production and reduced production costs. With such limited markets immediately available, the efficiency of production is a factor of vital importance and is recognized as such by all sections of industry.

That the waste in industry, which may be eliminated by standardization and simplification, plays a very important part in this national efficiency programme has been startlingly demonstrated in America, where in 1921 an inquiry was made by a Committee on Waste in Industry.

This Committee was appointed by Mr. (now President) Herbert Hoover, acting as President of the Federated American Engineering Societies. The inquiry covered six of the more important industries, viz. (1) building trades; (2) men's ready-made clothing; (3) boots and shoes; (4) printing; (5) metal trades; and (6) textile manufacturing. The report shows that, in these six industries, the losses and waste due to the restraint and dissipation of the creative power of those engaged in the industries amounted to nearly 50 per cent. The value of the output of manufacturing industries in the United States of America, according to the 1921 census, was over £12,000,000,000. Half of that, or £6,000,000,000, represents the loss in industry through wasted or misdirected effort. One of the most important recommendations of the Committee on the Elimination of Waste in Industry related to the encouragement by the Government, acting in co-operation with Industry, of a wide programme of industrial standardization and simplification. One-third of the total value of wasted effort was attributed to the lack of standardization and simplification of products, materials, and equipment. That means an annual loss of £2,000,000,000 from these causes alone.

No inquiry similar to that conducted by the Committee in America has been carried out in Australia, but in view of the high stage of industrial organization in the United States of America compared with this country, there is no reason to suppose that the losses in the Commonwealth, through similar causes, can be relatively less than in the United States. The average value of the output of our manufacturing industries in this country during the past three years was £397,000,000. Hence, applying the results obtained in America, the waste of effort, through lack of standardization and simplification in this country, is over £66,000,000 per annum.

2. Distinction Between Standardization and Simplification.

Standardization and simplification both aim at the reduction of the varieties of articles and materials produced with the main objects (*a*) of increasing the efficiency of production; (*b*) of improving the quality of the goods produced; and (*c*) of decreasing their cost. Whilst the economic objects are therefore similar, there is a definite distinction between the two.

Standardization means the reduction to, and comparison with, a definite single standard, i.e., the conformity to specified conditions as to strength, size, properties, chemical composition, &c. It involves the preparation and acceptance of a formal standard specification laying down definitely the properties and dimensions of the material or article and the tests with which it must comply.

Simplification is merely the process of reduction to a condition which is free from complexity, intricacy, and elaborateness. It does not involve the acceptance of a definite standard specification. It is based on commercial expediency and statistical data rather than on scientific investigation. It involves merely the elimination of undesirable or unnecessary sizes, qualities, and shapes, but does not involve—as standardization does—scientific and technical considerations as to the physical properties and chemical composition of materials. Briefly, simplification consists of a painstaking study of what an industry is producing, in ascertaining from sales records where the demand lies principally, and then in eliminating those types and varieties which are seldom called for.

Simplification does not, of course, preclude standardization in any line or industry. It is complementary to standardization and scientific research, and may be a logical preliminary step towards standardization.

3. The Advantages and Benefits of Standardization and Simplification.

The advantages and benefits of standardization and simplification may be summarized as follows:—

(1) A decrease in capital tied up in (*a*) raw materials and finished stock; (*b*) tools, patterns, machines, and equipment; (*c*) storage space.

(2) Increase in productive efficiency through (*a*) larger scale production; (*b*) longer runs; and (*c*) introduction of improved processes and machinery.

(3) Increase in labour efficiency through (*a*) higher skill through repetition of processes; (*b*) training of employees; (*c*) higher earnings through increased individual production.

(4) Improvement in quality of products.

(5) Decrease in cost of production.

(6) Speedy and reliable delivery from stock, because the manufacturer will be safe in producing, in dull seasons, standardized products for delivery from stock.

(7) Regularity of employment for the same reason.

(8) Greater efficiency and economy in advertising sales and marketing.

(9) Economy in purchase of raw materials.

(10) Finally, there are many other consequential benefits which follow in the train of those already enumerated. Control of materials, designing, accounts, and records are inevitably simplified. Technical and scientific research is stimulated. More thought, care, and energy can be concentrated on the production of a smaller number of varieties. Indecision is eliminated, and litigation and misunderstandings are decreased.

It is the sum total of all the cumulative interrelated benefits which gives the supreme value to standardization and simplification. To the manufacturer, the ultimate objects of standardization and simplification are greater output and reduced cost. To the consumer, the main advantages are decreased prices and improvement in quality. Both the producer and consumer are, therefore, vitally concerned in standardization and simplification.

4. Standardization in Other Countries.

In America, national, institutional, and company standardization has been in operation on a wide scale for many years, but more particularly since the investigations of the Conservation Division of the War Industries Board demonstrated the necessity for drastic measures towards the elimination of industrial waste and the conservation of manpower and material to meet the needs of war. The Bureau of Standards which is administered by the Department of Commerce, with its affiliated and subsidiary organizations, including the Division of Simplified Practice, the Marine Standards Committee, the Commercial Standards Group, and the Federal Specifications Board, is responsible for the standardization and simplification programme for departmental requirements, and is engaged also in an endeavour to co-ordinate the activities in America. Notable work has also been accomplished by the American Standards Association, the national standardizing body of the United States of America, which was founded in 1918 as the American Engineering Standards Committee. The American Society for Testing Materials is an organization which has achieved international repute. Founded in 1902, the Society now has a membership of over 4,200, and has issued 515 standards and tentative standards.

In Germany, the national organization, Deutscher Normenausschuss, which was founded in 1917, is quite independent of the Government and is supported by technical societies, trade associations, and individual firms. A significant feature of the movement in Germany is the strong support given to the national body by manufacturers and the thorough manner in which the principles of standardization generally have been adopted and applied. German national standards, over 2,000 of which have been published, are mainly dimensional in character and very few deal with quality or performance. Switzerland and Holland are collaborating with Germany. Whilst in Europe the sixteen countries which have national organizations are doing important and valuable work, the achievements of Great Britain and Germany are outstanding.

The establishment and record of achievements, in the principal manufacturing countries throughout the world, of twenty national organizations for standardization and simplification, all of which, with one exception, have come into being since 1916, are a convincing indication of the acceptance of the movement as one of the vital factors in modern industrial development.

5. Standardization in Australia.

The absence of uniform authoritative standards in Australia and the varied and uncoordinated requirements of purchasing authorities resulted in considerable inconvenience and waste effort, which naturally entailed increased cost of production, delay in the execution of orders, and a general lowering of efficiency and output. Many factors, including the demands of labour for higher standards of living, the importance of stimulating industrial enterprise and, more particularly after the World war, the keen urge of overseas competition, made it imperative that production efficiency be improved, involving the introduction, as a factor of considerable consequence in modern production methods, of the policy of standardization.

In the absence of an authoritative national body, a limited number of standards of an institutional character were issued by such organizations as the Institute of Science and Industry, the Australian Railways, the Electrical Association of Australia, and the Institution of Engineers, Australia. The urgent need for national standards still remained.

In 1918 the former Commonwealth Institute of Science and Industry convened a conference in the capital city of each State to consider the desirability of establishing an engineering standards organization in Australia. In the following year a definite scheme for the creation of an Australian Engineering Standards Association was set out in a pamphlet entitled "Engineering Standardization," by Mr. G. Lightfoot, published by the Institute of Science and Industry. The scheme of organization, formulated in the pamphlet, was discussed with representatives of the Institution of Engineers, Australia, and eventually, at a conference convened by the Institution in 1922, with the co-operation of the Australian Chemical Institute and the Australasian Institute of Mining and Metallurgy, the discussions culminated in a decision to establish a representative national body. With the approval of the Commonwealth Government, the Commonwealth Engineering Standards Association was founded in October of that year, with the gazettal of Sir George Knibbs, Kt., C.M.G., as Chairman. Subsequently, the prefix "Australian" was added, in order to avoid confusion with the initials of the Canadian Engineering Standards Association.

The Association was directed by a Main Committee comprising representatives of the Federal and State Governments, the Institution of Engineers, Australia, the Australian Chemical Institute, the Australasian Institute of Mining and Metallurgy, Inc., the Associated Chambers of Manufactures of Australia, and the Associated Chambers of Commerce of the Commonwealth of Australia. To assist the Main Committee in administrative matters, a local committee was established in each State, and in the Newcastle District and Federal Capital Territory. These Committees endeavoured to ensure that the interests of all sections of the Commonwealth should be adequately provided for.

The technical work of the Association in the preparation of specifications was conducted by sectional and special committees, over the decisions of which the Main Committee exercised no control excepting as found necessary in matters of policy. The personnel of sectional committees was appointed by interested organizations covering, as far as practicable, the whole field of industry and commerce in relation to the specific work in hand. This policy of delegating to interested parties the responsibility for the preparation of specifications intended for their own convenience is the basis upon which expectation of full agreement and consequent adoption of standards is founded. Avoidance of any suspicion of dictation led the Association to refrain from undertaking any new work on its own initiative. Suggestions for new work from those who had experienced a definite need for standardization were readily forthcoming, and were acted upon willingly by the Association, after a careful investigation had been conducted throughout the Commonwealth in order that it might be determined that the proposed work would fill a definite need, and was in accordance with the general desire of interested parties. A suggestion endorsed by such investigation, and

subsequently approved by the Main Committee, was put into operation by allocation of the proposed work, either to an existing committee or to a new committee appointed for the purpose.

The official establishment of the Standards Association of Australia, consummated at the first meeting of the Council in Sydney on the 10th September, 1929, will become a point of historical interest in the development of industrial efficiency in Australia. The Association has been formed by the amalgamation of the Australian Commonwealth Engineering Standards Association and the Australian Commonwealth Association of Simplified Practice, for the purpose of co-ordinating the activities of these two bodies which, through their closely allied movements, have already achieved notable results in an endeavour to secure increased efficiency of production.

At the time of amalgamation, the number of Sectional Committees of the A.C.E.S.A. in operation was twenty-nine, and covered such subjects as building materials, cement, colliery equipment, electrical industry, lubricants, machine parts, paints and varnishes, pipes and plumbing fittings, railway rolling-stock and permanent way, road materials, and structural steel, with others of a special character. There was also an important group dealing with subjects that were more in the nature of safety codes, and including boiler regulations, crane-hoist and lift regulations, electrical wiring rules and concrete structure, and steel frame building regulations.

The total number of committees and sub-committees of the Association was over 250, with a personnel of nearly 2,000 voluntary workers. One hundred and twenty-nine standards and tentative standards had been issued, and over a hundred others were in course of preparation.

These committees, and the organizations, and the general method of procedure were retained by the Standards Association of Australia when the amalgamation was effected.

6. Simplification in United States of America.

In a previous part of this article, the distinction between standardization and simplification has been explained. Whilst standardization in the engineering industry on a national basis has made considerable progress, the national organization of simplification has not yet developed to the same extent. In the United States of America, however, there has been remarkable progress during the past seven years in simplification as applied to manufactured products generally.

As a result of the state of affairs disclosed in the report of the American Committee on the Elimination of waste in Industry in 1921, Mr. Herbert Hoover, Secretary of the Department of Commerce, established a Simplified Practice Division. The function of this Division is the reduction of industrial waste through the elimination of unnecessary diversity in sizes, types, and styles, and other varieties of manufactured products. In taking this step, Mr. Hoover recognized that, in order to carry out the principles of simplification effectively, nothing less than a national clearing house would serve, and that the function could not be performed either by the Government or by industry alone. The work must be a co-operative undertaking in which the National Government must take the lead.

The procedure now followed by the Division of Simplified Practice is as follows:—

1. An industry, or, say, Association, first consults with the Division on the possibilities for simplification in their particular line.
2. Questionnaires are sent out and a survey is made of the actual varieties produced in the industry, showing the quantity of each produced. Usually this is carried out by the industrial or trade Association itself acting as the representative of the Department of Commerce.
3. The results are tabulated and studied by a Committee and a tentative programme of elimination is formulated.
4. The Department of Commerce convenes a General Conference, representing all interests—producers, consumers, and distributors. The tentative programme is presented to this conference for discussion and as a basis of action.
5. The recommendations of the Conference are then sent by the Division of Simplified Practice to the various interested organizations, including trade and technical associations, Government departments, &c., with a request that the organization formally accept the recommendations of the Conference.
6. After formal acceptance by a very substantial majority of interested bodies, the recommendations are published by the Department of Commerce as one of the series of Simplified Practice Recommendations.
7. Periodic revision is provided through the same machinery at intervals determined by the General Conference.

From this it will be seen that the Division's activities are purely co-operative in character. It orders nothing, it dictates nothing. The initiative must come from the industry itself. The Government in no way controls, it merely provides the necessary organization to enable the industry to make a careful analysis of its problems; to study the variety and demand; to bring together groups of manufacturers, distributors, and consumers; and to accomplish what may be thought desirable in the direction of simplification. The actual adoption of any steps recommended is strictly voluntary. On the official recommendations are printed the names of the manufacturers' associations or committees responsible for the proposed simplification. Each establishment in the industry then individually accepts or rejects any or all of the proposals at its discretion.

An official Department of Commerce Report regarding Simplified Practice recently issued reads as follows:—

"The month of December, 1928, marks the seventh anniversary of the establishment of the Division of Simplified Practice as a centralizing agency for bringing together the various elements of industry, and for endorsing and supporting their collective efforts toward eliminating the waste inherent in over-diversification of product.

"That period has seen the introduction of an organized procedure of non-regulatory co-operation, and its acceptance by American business. It has seen the simplification movement recognized as an integral part of successful management methods. Industry is constantly improving

the technique of its attack on costs of production and distribution, through a growing reliance upon simplification and standardization as two of production management's most powerful weapons. The effective use of these weapons has rewarded American industry in its effort to reduce the spread between the prices of raw materials and those of the finished products.

"The 95 simplified practice recommendations which are now in effect testify conclusively that interest in simplification has continued to spread. Evidence of the extent of this interest is clearly shown in the degree of adherence to programmes which have been audited at the end of their first year.

"It is futile to expect any simplified practice recommendation to function 100 per cent., but, when it can be demonstrated that manufacturers, distributors, and consumers of a product are conforming with an established simplified list of sizes and varieties to the extent of 80 per cent. of the total volume of business, it can be said that the recommendation is functioning successfully. To be specific, the average adherence to eleven of the recommendations recently audited was found to be 81 per cent. The minimum adherence was 54 per cent. and the maximum 96 per cent.

"The terms 'simplification,' 'simplified practice,' 'elimination of waste' and 'reduction in variety' have become definitely recognized as belonging in the vocabulary of industry showing that knowledge of this movement is nation-wide in extent.

"Applications of the principle of simplified practice are to be found on every hand. Many of them have come about through the initiative of individual firms or groups, in addition to those brought about through the concerted activity of entire industries working under the guidance of the Division of Simplified Practice.

"For example, a well-known manufacturer of electric lamps reduced his variety of lamps from 1,260 to 180 types. Lamp base styles were cut from 179 to 3. It is interesting to note that he was able to reduce prices of lamps one-half, over a period of twelve years, and that his sales increased nearly 75 per cent. in four years. He reduced his transportation and warehousing expenses, increased the efficiency of his employees, and can now supply the public with a better lamp for 25 cents than it could get in 1909 for one dollar.

"A manufacturer of self-opening and adjustable die-head chasers found that 80 per cent. of his business came from 2,000 varieties of 3.6 per cent. of his total line. The other 96.4 per cent. representing 53,000 varieties, brought in only 20 per cent. of the business. Elimination of the latter cut his inventory by $225,233, saving him $13,500 a year in interest charges, $12,500 in office pay-roll, and $10,000 in reduced obsolescence costs.

"Other examples of simplification, which may be mentioned are: files and rasps, forged tools, sheet-steel and grinding wheels, in the field of mill supplies, and construction materials, such as hollow building tile, roofing slate, face brick and so forth. Eaves, trough, and conductor pipe were reduced from 21 varieties to sixteen; paving brick sizes sustained a reduction of 94 per cent. The entire list of simplified sizes and varieties of building materials is of great interest to any one who contemplates the erection of a home or other building.

"Factual surveys of the benefits of simplified practice have brought out estimates of savings in materials, time and labour which run high into the millions of dollars. Fully half the industries which have adopted simplified practice found it difficult to interpret their benefits in terms of dollars and cents because of the existence of other contributory factors. All agreed, however, that the savings and benefits were important and none cared to return to the former condition of over-diversification.

"Documentary evidence is available to show that simplified practice is yielding benefits and savings in excess of $300,000,000 a year. Leaders in the various fields of industry have provided the Department of Commerce with conservative estimates regarding benefits in their respective lines."

7. Simplification in Australia.

As a logical corollary to the application of standardization to engineering products and materials through the activities of the A.C.E.S.A., attention was given in 1927 to the possibilities of the kindred movement of Simplified Practice in Australia. Already in 1924 the creation of an organization to undertake the work of simplified practice in Australia on a national basis had been advocated in a paper read by Mr. G. Lightfoot before the Australasian Association for the Advancement of Science.

On the initiative of Mr. G. A. (now Sir George) Julius, steps were taken in 1927 to create interest in the project to establish an Australian Association for Simplified Practice. A conference of representative individuals in technical, commercial, and industrial circles unanimously endorsed the proposed foundation of an Association. Representations were made to the Prime Minister, the Rt. Hon. S. M. Bruce, P.C., LL.D., &c., who convened a conference in Sydney, in July, 1927, at which the appointment of an Australian Commonwealth Association of Simplified Practice was agreed upon with a promise of sympathetic support from the Prime Minister on behalf of the Federal Cabinet. A meeting of a Provisional Main Committee was held immediately after the Conference. Prof. F. A. Eastaugh, of Sydney University, was appointed Chairman of the Association, and a suitable administrative organization was set up. Propaganda work was undertaken in all States, and, at the same time, preliminary investigations were undertaken with regard to a number of projects that had been referred to the Association for attention. Two projects definitely proceeded with as being of importance were uniform general conditions of contract for Government purchasing, and standard typography.

Whilst the initial investigations on other projects were proceeding, it became known that there was a prospect of considerable re-organization being effected to provide closer co-ordination between the two Associations for Standards and Simplified Practice, particularly with a view to participating more effectively in a proposed endeavour to co-ordinate these movements on an Empire basis. It was intimated to the Association that it would be desirable that the Association should not commit itself to further activities until the re-organization had been effected. The two sections of work in hand were therefore carried on, but otherwise the position remained practically unchanged up to the time of the amalgamation with the A.C.E.S.A.

8. The Standards Association of Australia.

On his return from a trip abroad, during which he gave particular attention to the work of agencies engaged in standardization and simplification, Sir George Julius, Chairman of the Main Committee, A.C.E.S.A., in an address to the Committee, reported the appointment in Great Britain of a Central Committee on Standardization and Simplification, and the initiation of a project to secure unification, as far as practicable, of standards throughout the Empire, and the development of simplification on an Empire basis. For Australia to participate effectively in this undertaking, it was essential that the activities in Australia should be re-organized and more closely co-ordinated. It had been proposed that a Conference be held in London of representatives of standardizing bodies throughout the Empire.

The Report of the British Economic Mission to Australia in 1928 contained recommendations for closer co-ordination between the Standards and Simplified Practice Associations, and the establishment of a closer link with Government through the Council for Scientific and Industrial Research. As the outcome of these recommendations, the two Associations received from the Prime Minister a notification that it was desired that a liaison be established between the Associations and Government through the Council for Scientific and Industrial Research, whose Chairman, Sir George Julius, had been requested to take steps to co-ordinate the two movements.

Consideration of the Prime Minister's request by the A.C.E.S.A. led to a decision in favour of amalgamation of the two Associations under one Main Committee. A recommendation to this effect, submitted to the Simplified Practice Association, was approved by that body. A basis of amalgamation having been accepted, a Council was appointed which held its first meeting in Sydney, on the 10th September, 1929.

The constitution of the Council includes the representation on the Main Committee of the A.C.E.S.A., to which have been added nominees of the Australian Institute of Architects, the Federated Builders' Association, the Australian Railways Conference, Federal and State Government purchasing branches, and additional representatives of the Chambers of Manufacture and Commerce.

Under this unified control, the two principal branches of work are continued, under the direction of a Standards Division and a Simplified Practice Division. Special provision has been made for a new line of activity to be developed under the Standards Division in relation to standard specifications for general commodities, in addition to the engineering standards and safety codes not receiving attention.

The way now appears open for a fully comprehensive effort through which the objective of the movement may, in a large measure, be realized.

Black (Braxy-like) Disease of Sheep in Victoria.*

By A. W. Turner, M.V.Sc.

The following constitutes an annual report of his work prepared by Mr. A. W. Turner. The report was submitted to the full Council in September, 1929.—Ed.

Work was commenced on this problem for the Council early in March, 1928, on my return from Europe. It will be recalled that for some time before my departure, and also during my stay abroad, I have been almost wholly engaged on black disease.

While at the Pasteur Institute, Paris, I was able to identify the causal organism of black disease in Victoria, and to show for the first time that, in spite of certain minor departures from the type cultures of Europe, it was really a race of the *Bacillus oedematiens*, an anaerobic spore-bearing bacillus that first came into prominence as one of the most important causes of gas gangrene in troops during the late war. Further, by utilizing the recent discoveries in the field of anatoxines, I was able successfully to vaccinate sheep against the black disease organism so that they subsequently withstood doses of culture sufficient to kill 20 unprotected animals. Continuing with the problem of the method of infection in black disease, I was led, as a result of experiments at Cambridge, to predict that sheep on infected pastures would very likely be carriers of spores in their internal organs, especially the livers, and succeeded in showing that liver injury brought about by the injection into it of ionisable calcium salts could bring about germination in the liver of spores of the black disease bacillus, this demonstrating the feasibility of the hypothesis that wandering liver flukes are the secondary factor in the development of black disease.

It will thus be realized that I was able to begin work for the Council on this problem under particularly advantageous conditions.

The work during the past year has been divided broadly into the following headings:—

(*a*) A survey of the economic importance and distribution of the disease.

(*b*) A complete investigation into its pathology.

(*c*) The causal organism of the disease, with a view to ascertaining whether the *B. oedematiens* is the sole cause of black disease. In this connexion, it should be noted that it is commonly found in anaerobic infections of the "acute gangrenous" type that the causal organism may be one of a group.

(*d*) The distribution of the bacillus in the soil of infected pastures.

(*e*) The pathogenesis of black disease, with a view to determining whether the sheep fluke *Fasciola hepatica* is the accessory factor in the production of the infection.

(*f*) The examination of organs of experimentally infected laboratory sheep and of apparently healthy sheep on infected properties, with a view to determining whether spores of the bacillus can remain in such organs in a latent state.

(*g*) The vaccination of sheep in the field against black disease, with the vaccine used by me at Pasteur Institute.

* Typescript received 9th August, 1929.

Without the help of Mr. D. Murnane, B.V.Sc., who was detailed to assist me particularly in the field work, it would have been impossible to accomplish much; as it is, I have found it impossible for one bacteriologist to accomplish all the laboratory work that I had set myself in the time originally decided upon. For that reason, there still remains a large amount of material on hand that I have been unable to examine yet. The appointment of Mr. Wright as laboratory assistant to me has considerably lightened the load, and I am hopeful of being able to attack the accumulated material very soon.

The results of my investigations to date have been of very great interest. As complete a survey as possible has been made of the economic importance and distribution of the disease. Outbreaks have been investigated in the Kerang, Mansfield, and Homewood districts, and at Pakenham, in Victoria, and in the Southern Riverina of New South Wales. It has been found that large numbers of sheep are lost annually from this disease, the mortality ranging in our experience up to 25 per cent. of the flock. It affects mostly the irrigated or well-watered districts of Victoria, where the properties are comparatively small—the greatest numerical losses of which we have learned being 280 sheep out of 8,000—in this case only 3½ per cent.. The heaviest percentage was recorded when one small farmer lost 200 out of 260 sheep—equalling 77 per cent. But the New South Wales workers, who deal with much larger properties, report very large losses, such as 1,500 out of 2,500 and 2,500 out of 5,000. The late Dr. Dodd considered that the disease cost New South Wales £500,000 sterling per annum, and since there is no doubt that the disease has spread greatly after his estimate was formed, and since the value of sheep has subsequently increased, we agree with Edgar and Rose that £1,000,000 is a conservative estimate of its annual cost to Australia at the present time.

The pathology of the disease has been and is being exhaustively studied, and it is hoped to bring this part of the investigation right up to date. As a result of this study, I have been able to trace the evolution of fluke tracks in the liver into the well-known necrotic areas containing the bacilli, thus confirming the fluke hypothesis.

A large number of strains of organisms have been isolated from cases of black disease, under the most rigorous conditions, contrasting sharply with the methods employed by certain European investigators of the so-called "braxy" or "bradsot" group of diseases. I, therefore, consider my results to be trustworthy.

For the work on the causal organism which is still in progress, only material from cases that we have seen die or have killed have been used, and the post-mortems have been made immediately.

The organisms we have isolated are of the same type as that with which I worked in Paris; but on occasions I have met with more than the one species of organism, thus bringing the disease more into line with others of the same type (such as blackleg in cattle, and as gangrene in man).

With regard to the presence of the bacillus in soil, a large number of samples have been collected and are awaiting analysis.

The pathogenesis of the disease has received a large share of my attention, but the work has been largely held up through lack of parasitological assistance.

The only worker available to give this assistance has been Dr. I. Clunies Ross, but as he has been very fully occupied with his own investigations the amount of help he could give has been very limited, though ungrudgingly given. However, with one batch of fluke cercariae that he sent from Sydney, I was able to reproduce in a small number of guinea pigs typical black disease lesions. Lack of further cercariae has made it quite impossible to carry the work on further to sheep; so that to date failure to reproduce black disease experimentally in sheep must be admitted.

The latency of spores of anaerobes, particularly of the black disease bacillus, in the bodies of apparently healthy animals, and the relation of this phenomenon to the pathogenesis of black disease has received special attention. The subject is of extreme academic and practical importance, both in this disease and in anaerobic infections of man and animals generally. I have shown that in the majority of cases spores of the black disease bacillus, when freed of their adherent toxin by washing and heating, are quite innocuous when inoculated or fed to experimental animals, though at the same time perfectly viable and potentially pathogenic; that they then are transported to various organs, particularly the liver, spleen, and bone-marrow, where they lead a latent life in equilibrium with the host; and that they may remain in those organs for very long periods, up to nine months. The examination of a large number of apparently healthy sheep from an infected property has revealed that many of them were carriers of spores, and that this carrier state was evidently not influenced by previous vaccination. The mechanism of their transportation and of their storage has been studied, and some hypotheses on the factors influencing the germination of anaerobic spores *in vivo* have been formulated. The practical conclusion to be drawn from these experiments is that in nature the common method of infection is by ingestion, that spores swallowed by sheep with the food reach the internal organs and lie latent there for long periods of time, and that such "carriers" may be dangerous spreaders of the disease.

With regard to vaccination, nearly 8,000 sheep have been treated with absolutely no bad results. In every case, only one-half of the sheep on any given property have been vaccinated, so that adequate controls have been kept. For the purposes of a first year's trial, the vaccine was made from one strain of *B. oedematiens* only, and two injections were given at a month's interval. In a few cases, a third injection has been given later. The results of vaccination have been excellent on the property from which the strain was derived, three injections having totally checked the disease, while two injections reduced it by 75 per cent. On other properties, results have been often very satisfactory, but not to such a degree. In some instances, little benefit has been noticed. The result of the year's vaccination is thus extremely gratifying, but we have learned that still better results may be expected by making the vaccine polyvolent, that is, by combining in it several strains. From the point given of transport, however, it is felt that work could very profitably be carried out on the concentration of the vaccine to reduce its bulk.

During the course of the investigation, the important observation was made that bovines may contract black disease. A case was obtained in a milking cow in a black disease district, and is the first case on record of what is really a new disease of bovines. Whether this disease is ever likely to assume important proportions remains to be seen; but if it does the results of our work on the sheep disease, particularly with regard to vaccination, will be of great importance in its control.

Summing up, satisfaction generally is felt with the results of the work tempered with disappointment as regards the lack of parasitological assistance. It is felt that it is essential to prove the role of the liver fluke in the pathogenesis of black disease, and for this purpose an adequate supply of cercariae is absolutely necessary. Dr. Ross has promised to try to get them in Japan for me, but in the meantime I am endeavouring to breed the transmitter snail, *Limnea brazieri,* with a view to infecting them with fluke. My previous attempts in this, a specialist undertaking, have, however, been fruitless. Before abandoning the project, it is necessary to make every attempt to obtain specialist aid on this point. It is very disappointing to have obtained such suggestive results with guinea pigs and then to be held up in the crucial sheep experiments through lack of material.

I am at present exploring the possibility of getting some person with the necessary time and experience to carry out the breeding and infesting of snails for this purpose.

Caseous Lymphadenitis.

PAPER 1.

An Experimental Inquiry as to the Common Modes of Natural Infection in Sheep.

By H. A. Woodruff, M.R.C.V.S., M.R.C.S. (Member of the C.S.I.R.), and D. T. Oxer, B.V.Sc.

From a study of the figures obtained in Australian abattoirs relating to the distribution of lesions of caseous lymphadenitis in sheep, it is evident that the prescapular and prefemoral lymphatic glands are by far the most common sites. Thereafter the lungs and their associated lymph glands (bronchial and mediastinal) are next in order of frequency. Glands of the upper part of the alimentary tract (the parotid and pharyngeal glands) are not very commonly affected, and the mesenteric glands even less commonly.

Another point of importance is the age incidence of the disease. As a general statement, it may be said that lambs are comparatively rarely affected, whilst with every year of age the incidence goes up, to reach a maximum in sheep 4 or 5 years old. It is also of some importance to note that the sexes seem to be fairly equally affected.

With these facts in mind, it was decided to attempt some experiments, having in view the determination of the method of natural infection. The question of lung infection was for the moment considered not to be primary, but probably secondary to skin infection, and possibly brought about by a predisposing factor such as infestation with lung worms.

Along with this inquiry into methods of infection, attempts were made to discover a reliable serological test for the detection of infection in experimental animals. This is an urgent desideratum, so that in any experimental work on artificial infection it may be ascertained that the experimental sheep are themselves absolutely free from natural infection. These experiments were not continued and no very helpful results accrued.

1. The Causal Organism.

A number of strains of the organism were recovered from lesions having the naked-eye characters of caseous lymphadenitis, and in no case did we find an organism other than the Preisz-Nocard bacillus responsible for the lesions. The various strains were not all equally potent toxin formers. Broth cultures, from a spleen infusion broth, buffered as recommended by Ramon Berthelot and Amoreu for diphtheria toxin production, from 4-8 days old, were used. Filtration through an L_2 filter appeared to cause little or no loss of toxin. Two guinea pigs of similar weight were injected with 1.5 c.c. of filtered and unfiltered broth culture, respectively, and both died in 24-30 hours. On the other hand, of 28 guinea pigs used to test toxicity of broth filtrates, only five died in under 30 hours, and subcultures tended to become less toxic. In ordinary nutrient broth, the most vigorous growth was obtainable when the broth was distinctly alkaline up to a

pH of 8.13. Two of the local strains, and one strain received from Professor Vallée, were tried on the various sugars. The local strains produced acids strongly in tubes containing maltose, glucose, and dextrin, not quite so strongly in galactose and saccharose, and not at all in lactose, laevulose, raffinose, and mannite. The French strain differed in that it produced acid from laevulose. No gas was formed.

2. Experimental Infection of Lambs.

By the courtesy of an interested owner, we were enabled to try the effect of various methods of infection in lambs. Fourteen merino lambs, all under ten days old, and most of them under five days, were tested, two by feeding with culture, four by application of culture to the umbilicus, and the rest by means of its application to wounds in various situations.

Experiment No. 1.

Lambs Nos. 1 *and* 2.—The lambs were several days old, the umbilicus of each being dry and well healed. A cotton wool swab soaked in a broth culture was dabbed on the umbilicus. Examined manually in six weeks' time the umbilicus in both lambs was normal. Prefemoral glands in both limbs were of equal size but enlarged.

Post Mortem Examination at 2½ Months.

Lamb No. 1.—Both prefemoral glands caseous and about the size of a marble. No other lesions, and the umbilicus was normal. The Preisz-Nocard bacillus was recovered in pure culture.

Lamb No. 2.—Both prefemoral glands caseous, but not enlarged to any great extent. Right superficial inguinal gland contained a small caseous abscess. Right external iliac gland caseous, not of abnormal size. Organism recovered in pure culture.

Experiment No. 2.

Lambs Nos. 3 *and* 4.—The umbilicus of each of these two lambs was painted with culture on a swab shortly after birth, when the umbilicus was moist.

Lamb No. 3.—When a manual examination of superficial lymph glands was made after six weeks, both prefemoral glands seemed enlarged, the left slightly larger than the right. Umbilicus normal.

Post Mortem Examination at 2½ Months.

Left prefemoral and left superficial inguinal glands fibrous and hard. The prefemoral gland was slightly enlarged. Each gland contained an abscess filled with thick greenish pus. One small nodule the size of a millet seed in the anterior lobe of each lung, containing greenish pus, and with a firm translucent fibrous capsule which was surrounded by a slight area of inflammation. The organism was recovered in pure culture from the left prefemoral gland. Section of the lung nodule showed a fibrous capsule surrounding necrotic material (cell detritus, leucocytes and many organisms of morphology similar to B. Preisz-Nocard).

Lamb No. 4.—Right superficial inguinal gland caseous, but not enlarged. Left prefemoral gland congested, but not enlarged. Right and left prescapular glands oedematous. No cultures made as the caseous lesion of the gland appeared characteristic.

Experiment No. 3.

Lambs Nos. 5 and 6.—Both lambs several days old, the elder being 10 days old. Both quite healthy.

Three broth cultures (5 c.c. each) were emptied into 6 oz. of warm milk, which was then fed to the lambs in equal parts. A progress report in a fortnight's time said that the lambs were perfectly healthy, and at no time appeared ill. The mother of each lamb was examined at time of post mortem for signs of mastitis, but no abnormality was detected.

When manually examined after six weeks both lambs appeared normal, except that No. 6 had an enlarged parotid lymph gland the size of a marble.

Post Mortem Examination at 2½ Months.

Lamb No. 5.—Left prescapular lymph gland enlarged and oedematous. All internal lymph glands normal, and no lesions of the m.m. of alimentary canal. Two small nodules the size of a millet seed in the left lung. Each had a firm fibrous coat with a narrow surrounding margin of inflammation, and contained thick greenish pus. No other lesions. Sub-culture from enlarged prescapular gland sterile.

Lamb No. 6.—Bronchial lymph gland showed a small caseous focus ¼-inch diameter containing greenish pus. Left prescapular gland oedematous and slightly congested. Parotid lymph gland normal. The organism was recovered from the bronchial gland.

Experiment No. 4.

Lambs Infected through Wounds.—(The infections in this series may be termed massive infections when the method is compared with any natural infection). Progress report after a fortnight stated that none of the lambs infected through wounds were thriving.

Lambs 7 and 8.—These lambs were castrated and the wounds immediately dabbed with culture by means of a cotton-wool swab. They were also tailed at the same time.

Lamb No. 7.—Manual examination after six weeks revealed the following condition:—Left fore knee was enlarged. Scrotum was unhealed and showed signs of discharge. One cord was thickened.

Post Mortem at 6 Weeks.

The stump of the spermatic cord was surrounded with thick greenish pus. The stump of the spermatic artery was not healed, and appeared to contain an infected thrombus.

The left carpal joint (knee), which was enlarged, contained cloudy synovial fluid with flocculi of thick greenish pus. A pure culture of Preisz-Nocard bacillus was recovered from the knee joint.

Lamb No. 8.—Manual examination showed that the left superficial inguinal and prefemoral glands were slightly larger than the right.

Post Mortem at 2½ Months.

Right superficial inguinal gland caseous, but not enlarged. Small local infection of the tail about ¼-inch diameter. Unfortunately organism was not recovered on culture, but we have no reason to doubt the specific nature of the lesions.

Lambs Nos. 9 *and* 10.—These lambs were tailed and the wounds painted by means of a swab impregnated with culture.

A progress report after 2 weeks stated that both lambs were very lame, one carrying the left hind and the other the right fore limb. In both cases the affected limb appeared swollen and sore.

Lamb No. 9.—Manual examination at six weeks. Lameness due to arthritis of left tarsal joint (hock). No visibly enlarged glands.

Post Mortem at 6 *Weeks.*

The popliteal and renal lymph glands on the left side seemed enlarged, but were not caseous. There was pus formation at the end of the tail stump, and an abscess extending about 2 inches towards the base of the tail. The left tarsal joint was swollen, and contained cloudy synovial fluid with greenish purulent flocculi. The organism was recovered in pure culture from the hock joint, but cultures of popliteal and renal glands were sterile.

Post Mortem at 6 *Weeks.*

Lamb No. 10.—Right prescapular gland enlarged and oedematous. The right fetlock joint of the front leg was swollen, containing cloudy synovial fluid and greenish purulent flocculi. Organism recovered in pure culture from fetlock joint, but culture of right prescapular lymph gland negative.

Experiment No. 5.

Lambs Nos. 11 *and* 12.—In each case the following technique was adopted—

(1) A sterilized sacking needle was dipped in broth culture, and with it the skin on the dorso-lateral aspect of the left leg was punctured.

(2) Two splinters of wood were soaked in culture, one was inserted under the skin in the dorso-lateral aspect of the upper part of the arm and one under the skin on the inner aspect of the elbow.

(3) An incision about $\frac{3}{8}$-inch long was made on lateral surface of the left hind limb just above the hock. The right side of each lamb was left as a control. The lambs were in good condition at the time of the post mortem, and well grown.

Lamb No. 11.—Post mortem examination at $2\frac{1}{2}$ months. The left precrural gland contained characteristic greenish pus, was fibrous but not enlarged. Left axillary gland was also caseous, but not enlarged. Organism recovered from the axillary gland.

Lamb No. 12.—Left superficial inguinal gland only, was caseous but not enlarged. Other glands normal.

Lambs Nos. 13 *and* 14.—Control lambs of same age as the others. Perfectly healthy in all organs and glands.

3. Summary.

(1) Lambs from 1-10 days old developed glandular lesions when infected by various means with a not very virulent strain of Preisz-Nocard bacillus.

(2) Two lambs, the umbilicus of each being dry and apparently healed, had the umbilicus painted with culture. Both developed caseous lesions in the prefemoral gland, and one of them in the superficial inguinal and internal iliac lymph gland.

(3) The unhealed moist umbilicus of two lambs was painted with culture. One developed caseous lesions in one prefemoral, and one superficial inguinal gland, also small nodules in the lung; the other developed a caseous lesion in the superficial inguinal gland.

(4) Two lambs, the older being ten days old, received a massive dose of culture *per os* in warm milk, and developed only minor lung lesions and one a small caseous nodule in a bronchial lymph gland.

(5) Lambs infected through wounds always developed caseous lesions, the most severe being through castration and tailing wounds, when in several cases severe distant foci were developed in the joints. Wounds caused through placing infected wood splinters under the skin led to caseous lesions being developed in the regional lymph glands.

4. Conclusions.

These experiments were carried out on a property where the disease is relatively rare. The lambs were of such an age that the chances of natural infection were practically negligible, and it is significant that in every case infection of a wound with culture was followed by the production of lesions of caseous lymphadenitis within 3 months.

The two lambs which were fed with a large dose of culture both developed lesions, but these were few in number and of small size, so that infection by this means does not appear to be easy to produce.

Taking into consideration the relative freedom from infection of lamb carcasses at abattoirs, and the demonstrable ease of infection of lambs by wound inoculation, it appears safe to say that wound infection in lambs is not a serious material factor in the prevalence of caseous lymphadenitis in sheep.

PAPER 2.

Observations on the Age and Sex Incidence in an Infected Flock in Relation to Possible Routes of Infection.

By H. A. Woodruff, M.R.C.S., M.R.C.V.S., and T. S. Gregory, B.V.Sc., Veterinary Research Institute, University of Melbourne.

1. Introduction.

In the course of this investigation, a large number of lesions from characteristic cases of the disease have been examined bacteriologically by one of us (T.S.G.), and in no case has any organism other than the Preisz-Nocard bacillus been found responsible. Other workers (particularly in France) have described cases apparently similar to those typical of caseous lymphadenitis in which the cause was either a micrococcus (Micrococcus of Morel), or *B. pyogenes*. In all our cases the one causal organism has been responsible.

The strains of B. Preisz-Nocard isolated by us have corresponded in general characters with those originally described for Australia by Cherry and Bull in this University in 1899. The fermentation reactions of a number of the strains tested out are as follow. Acid is produced in serum water containing glucose, laevulose, maltose, mannose, dextrin and, to a small extent, with galactose and saccharose. There is

no acid production in lactose, dulcite, mannite, sorbite, inulin, raffinose or rhamnose. As regards toxin production our strains showed no unusual features.

2. Natural Modes of Infection.

Whilst this work was in progress, an opportunity occurred for studying the incidence of palpable gland lesions in a heavily infected flock bred on a station in the Riverina. The owner had frequently noticed the existence of caseous lymphatic glands in sheep killed for food, and facilities for a thorough inspection at, and subsequent to, shearing were readily afforded us. A preliminary examination of a small number of sheep soon confirmed the fact that lymphadenitis was prevalent and suggested that the percentage of infection was high.

The point of view of the pastoralist was interesting and significant. Generally, from an economic standpoint the disease has little direct interest for the owner. No actual loss or inconvenience from caseous lymphadenitis on the station itself was admitted, until during the course of our inspection the owner recognized that the markedly enlarged prescapular and prefemoral lymph glands, which were pointed out to him as characteristic of the disease, were in fact the same condition which is described locally as "boils." This condition is indeed sometimes treated by incision and evacuation of the pus. Apart from the trouble involved in this local treatment, no serious inconvenience is experienced, and no mortality as a result of the disease is recognized.

3. Manual Examination of Sheep.

In order to obtain a comprehensive estimate of the percentage of infected sheep, drafts were examined as they came from the shearing shed, and classified according to age. The examination consisted of palpation of the prescapular and prefemoral glands in every animal,* and other glands such as the submaxillary and supramammary occasionally. This, of course, did not give the true percentage of infection, since other glands, such as the popliteal and internal glands, could not be palpated. It did, however, give some indication of the extent of the infection, and it provided a basis for comparison of the infection in animals of various ages. About 200 sheep of each age were examined as they entered the branding race, and this number was taken as being representative of each group.

The detailed results are as follow:—

Lambs.—These were dropped during March and April, and marked at the end of May, i.e., two months before examination. Examination of about 250, composed of mixed sexes, failed to show any enlargement of the prescapular or prefemoral glands. There was some difference in the size of the glands in different lambs, but in every individual those on the right and left sides felt exactly the same, and since both sides are very rarely affected to exactly the same extent with lymphadenitis, little doubt was left regarding their normality. There were no indications of suppurative processes in the region of the scrotum or umbilicus.

One-year-old Ewes.—5.8 per cent. of these were found to be affected. The number of enlarged prefemoral was greater than that of enlarged prescapular glands. A noteworthy point was that about half the affected glands were "markedly" enlarged, that is, they approximated

* The appended sketch will indicate the position of these glands to the layman.

to the maximum enlargement of affected glands found in the older sheep. This indicates that, during the course of twelve months, the maximum enlargement can be reached. The other half of the affected glands were slightly but definitely enlarged. Of the total number of affected glands 9 per cent. were discharging.

Two-year-old Wethers.—In this class, 27 per cent. were affected, and 11 per cent. of these had either suppurating lesions or marks of an old sinus leading from an affected gland to the exterior.

Three-year-old Wethers.—Of these, 39 per cent. were affected, and 10 per cent. of this number had suppurating lesions.

Four-year-old Ewes.—39 per cent. were affected, and 8 per cent. of these had suppurating lesions.

Five-year-old Ewes.—30.5 per cent were affected, and in these, suppurating lesions were found in 9 per cent.

Six-year-old Ewes.—30.6 per cent. were affected. When these were examined the number of discharging lesions was not particularly noted.

Rams.—These had been purchased from widely separated properties, and they were of mixed ages. Only 30 were examined, and three of these had one or more moderately enlarged glands. These sheep had been shorn a week previously, and several had shearing wounds which were exuding greenish-coloured pus. It is to be noted that rams are not shorn as closely as other sheep and these appeared not to have been cut so much, and moreover, they are often shorn first, and so are not exposed to such risk of infection from contaminated yards and shears as are the later shorn sheep.

TABLE 1.

Age and Description.	Percentage Affected.	Percentage of affected Sheep with suppurating Lesions.
Lambs	Nil	Nil
1 year old ewes	5.8	9
2 year old wethers	27.0	11
3 year old wethers	39.0	10
4 year old wethers	39.9	8
5 year old ewes	30.5	9
6 year old ewes	30.6	not determined
Rams	10.0	..

In considering the table, the outstanding feature is the apparent absence of infection in the lambs, the relatively small amount of infection in the one-year-old ewes, and the greatly increased amount in the older sheep.

On this property infection does not appear to occur as the result of docking and marking. In abattoirs, the number of caseous glands among the superficial inguinal and caudal lymph glands which drain these areas is very small. The more important lesions of caseous lymphadenitis occur in such glands as the prescapular, prefemoral, and popliteal. Shearing wounds are more likely to provide a route of infection for these latter glands, and the increase of infection with increased age, and therefore more numerous shearings strongly suggests that this is a main factor.

4. The Probability of Infection at Shearing.

The almost universal method of machine shearing is a very severe ordeal for sheep. Particular note was taken of the number of cuts and abrasions which the animals bore after leaving the shearing board, and they were too numerous to specify. Generally speaking, the parts most constantly cut were those in the region of the prefemoral gland, particularly in the fold of the flank, and about the neck and shoulders where the skin is much wrinkled. Cuts on all the legs were also very numerous. If such cuts were to become infected with the causal micro-organisms, caseous lymphadenitis in its usual distribution would result. There was an average of about 100 cuts and abrasions on each sheep, and very commonly as many as twenty pieces of skin of appreciable size were cut away.

The amount of cutting varied according to the animals. Merino lambs have a skin which is loose and often wrinkled in parallel lines, so that they suffered to a great extent as the machines traversed the ridges. The three-year-old wethers, which were also wrinkled and carried a very heavy fleece, were also difficult to shear. Some of the older ewes, in fat condition and smoother in the skin, were less extensively cut.

The question then arises as to what material is likely to carry the micro-organism or micro-organisms which will produce caseous lymphadenitis, and when does this material enter the wounds? To suggest possible answers, the progress of a sheep through this particular shed will be outlined.

Sheep are first driven from the paddocks into the drafting yards. They arrive here with their fleeces full of dust from the paddocks, material which may already be infective, and to this is added a considerable quantity of yard dust, consisting of pulverized débris and dung from sheep which have preceded them. After drafting, they are retained in the shed pens overnight and shorn the next day. Immediately before shearing they pass through the catching pens, the slotted floor of which forms the roof of the counting pens down into which the sheep are pushed through a chute after being shorn on the board.

On the shearing board there are many chances of infection. If, for instance, the soiled wool of the crutch and hind parts carries lymphadenitis-producing germs, or if the latter are present in the dust in the fleece, then the shears might directly inoculate this into the many cuts over the surface of the body. Furthermore, it has been mentioned that approximately 10 per cent. of the palpably infected live sheep were, or had been, suppurating at the site of the infected glands, so that shears must inevitably become heavily soiled with pus. How long they would remain infected considering the rapid movement of the blade and the traversing of a heavy fleece is a matter for conjecture. Nevertheless, it seems probable that a considerable percentage of sheep become infected in this way. It might be asked if any lambs could become infected in this way, since they appear to carry no original infection, and therefore no suppurating lesions. The answer to this is that lambs are commonly shorn immediately after all their parent ewes are shorn, and since a number of these ewes had suppurating lesions the risk to lambs is apparent.

Since, on this property, three in every hundred of the older sheep had lesions showing obvious evidence of suppuration, it is practically certain that at least the sheep which immediately follow these animals with discharging abscesses will receive infective material by means of the shears.

After being shorn, the sheep are pushed down the chute into a counting pen on the floor of which is about two inches of fine dust, consisting of minute wool fragments, pulverized sheep dung, &c., which have dropped through from the floor of the catching pen above.

Generally the animals do not remain here long, but merely stir up the dust on their way to the outside portion of the pen above ground. After remaining in this pen for about 2 hours, they are counted and driven through the race yard and branded in the special race. They may then be further retained from one to several hours before being liberated. The race yard and race soon have a thick coating of dust, which is stirred up in the process of driving. Lambs, during branding, become particularly dirty in the race, since they tend to pack tightly, and many are trampled upon. The majority of the sheep bear wounds on the extremities, and these wounds cannot fail to become thickly coated with a film of this dust, whilst wounds and abrasions on the body are more lightly coated.

5. Minimizing the Risk of Infection.

Shear the Lambs First.—Several methods of reducing the risk of infection at shearing suggest themselves, but the practicability of the procedure has to be determined in each case. The most obvious and outstanding precaution is to *shear the lambs first of all.* If the shed has not been used for 12 months no infection is likely to have remained alive from previous infected sheep. The machines and boards, the floors and pens, are all clean. *In succeeding years the order will be lambs first, then 1-year-old sheep, and so on.* With older sheep, in which a percentage would be infected, the machines might well be immersed, whilst still running, in a bath containing a reliable disinfectant after each sheep, so as to be clean for the next one. *It seems desirable that sheep with palpably enlarged and with suppurating glands should be drafted out and shorn last.* This would be a difficult procedure with sheep carrying a heavy fleece, and especially when burrs and thistles are prevalent. It might be possible to draft out all sheep with enlarged glands after shearing and to keep them away from the other sheep all the year, as well as to shear them last, but an owner could hardly afford to segregate 30 per cent. of his ewes and not breed from them. The selling of obviously affected sheep would not be agreed to owing to the attention they would attract at an abattoirs, and because there is no direct economic pressure.

A further possibility, that of dipping directly after shearing, might be suggested, but owners prefer a slight growth of wool for retention purposes before dipping in arsenical dips. Moreover, the latter might be dangerous if used when the animals had been harshly treated at shearing.

Dipping in non-poisonous dips would be possible, but it is not a convenient operation to combine with shearing, and very often the weather is unsuitable.

One much discussed prophylactic measure consists in the annual vaccination with suitable vaccine or anaculture, or premunition by inoculation into the dewlap of an allied or attenuated organism. Such a method depends for its success on (1) the immunizing value of the vaccine used, and much experimental work would be necessary to determine this point. French workers who have used a vaccine more largely than any one else, are not very optimistic, even if their results were obtainable in Australia. It also depends on (2) the willingness of sheep breeders, who so far feel very little direct loss on account of the disease, to go to the expense each year of a vaccination, entailing two injections at an interval of ten days, of all sheep, beginning in the first year with unshorn lambs only.*

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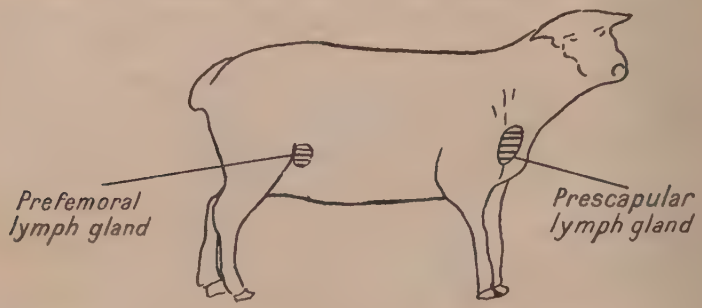
* Since the above paper was written, a piece of evidence which seems to support the conclusions reached therein, has been communicated by Mr. R. P. Allen, B.V.Sc., Chief Veterinary Officer, Commonwealth Department of Markets and Transport.

Two flocks of lambs, the one numbering 451 shorn lambs and the other 190 woolly lambs, from adjoining properties near Tocumwal, were killed at the Ballarat Freezing Works on 1st October. Of the 451 shorn lambs, 40 were found infected with caseous lymphadenitis, and were rejected for export. Of the 190 woolly lambs not one was infected with caseous lymphadenitis. The veterinary inspector adds the comment :—" The fact that most of the lesions were in the prescapular and prefemoral lymph glands, also confirms the opinion that wounds sustained during shearing were the seat of inoculation by the Preisz-Nocard bacillus. Gross abscess formation was noticeably rare, the infection being apparently of recent date."

The merino lambs (451 lot) were shorn the second week in September.

H.A.W.
T.S.G.



A sketch to indicate the position on the animal of the most commonly affected glands, which can be felt during life. The prescapular is situated just in front of the lower part of the shoulder blade. The prefemoral (or precrural) is situated in the middle of the fold of skin forming the flank, just above and in front of the stifle joint.

The Ripening of Bananas.*

Interim Report by Committee appointed to deal with Banana Ripening and Transport.

1. General.

In 1928, the Council decided to undertake work on the maturation of bananas, and a committee was appointed to control this work. This now consists of Mr. W. Ranger, B.Sc., Manager, Committee of Direction of Fruit Marketing, Queensland (Chairman), Dr. L. S. Bagster, Lecturer in Applied Chemistry, University of Queensland, Dr. W. J. Young, Associate-Professor of Biochemistry, University of Melbourne, and Mr. G. Williams, Director of Fruit Culture, Department of Agriculture and Stock, Queensland.

By permission of the two Universities, experimental ripening rooms were erected, one set at the University of Queensland, under the direction of Dr. Bagster, the other at the University of Melbourne, under Dr. Young. Mr. F. E. Huelin, B.Sc., and Mr. E. W. Hicks, B.Sc., were appointed by the Council as assistants for the work in Brisbane and Melbourne, respectively.

Experimental work was commenced in Brisbane early in February, 1929, and in Melbourne at the end of March, 1929, whilst check experiments have been conducted in a small commercial ripening room on the premises of the Committee of Direction in Brisbane.

The experimental work is not yet completed, but it seems desirable at this stage to indicate to the commercial ripeners of Australia what progress has been made, and what would appear to be a satisfactory commercial procedure based on such experimental work.

2. Factors Concerned in Ripening.

The Effects of Coal Gas in Ripening.—In the course of the investigation it was found that the presence of coal gas in the atmosphere exerted a very marked action upon the ripening of bananas.

Not only does the coal gas accelerate the ripening of bananas very considerably, but it has a marked effect in producing uniform ripening throughout the bunch or the case. Under ordinary ripening methods, some bananas are frequently much behind others. The addition of coal gas results in the ripening of such bananas being hastened considerably. Bananas ripened under this process are of excellent colour and flavour, and maintain their condition for a considerable time. The effect of this gas is especially marked with immature bananas.

Ethylene.—It has long been known that ethylene exercises a marked effect in accelerating colour change in the ripening of various fruits and vegetables, and a good deal of work in this connexion has been done in the United States of America. Ethylene, however, is fairly expensive, and not always easy to procure. The coal gas method is apparently more practical for use in Australia. Ethylene, of course, is a usual constituent of coal gas, being present in small quantities, and it is possible that it is solely responsible for the accelerated ripening. The quantity present in the amount of coal gas used, however, is so very small compared to the proportion found effective in the United States,

* Typescript received 15th October, 1929.

that it is possible that other constituents also may contribute to the effect. Active search is now being made to discover just what is the real cause of the accelerated ripening, whether it be through ethylene, carbon monoxide, or any other constituent that may be present in coal gas.

Accurate Dosage of Coal Gas Necessary.—The addition of too much coal gas, or the application of too high a temperature results in undue softening of the fruit, and produces an unsatisfactory article of very poor appearance, and the quantity of coal gas suggested below should be strictly observed.

Time Required in Ripening.—During the winter months, it was found that the reduction of humidity and the change to constant ventilation was necessary some time during the fourth day. In about another 24 hours the bananas would be sufficiently "hardened off" for country trade.

Actual Commercial Tests.—Tests made on a commercial scale by sending such fruit to country centres in Queensland resulted in many letters of approval and requests for a continuous trade in such fruit. Definite increases in sales were reported as a direct result of the improved quality of the bananas ripened under the method outlined.

Effect of Light.—It is possible that absence of light may prove a factor in developing a satisfactory colour. This point is not fully established, and is only mentioned to indicate the lines upon which the research is proceeding.

3. Further Work.

It is expected that a complete report of the investigating committee will be available in a few months, when suggestions for procedure and for construction of rooms will be offered in more detail. Meanwhile, the following suggestions are put forward tentatively, together with a description of appliances and methods by which the conditions may be attained. Any queries will be gladly answered if addressed to members of the investigating committee, either through the Council for Scientific and Industrial Research, or directly.

4. Suggested Procedure.

1. *Treatment until bananas begin to change colour—*
   - (*a*) Keep temperature at 68 deg. F.
   - (*b*) Maintain a relative humidity (moisture content) of 85 to 90 per cent. (i.e., the wet bulb of the wet and dry bulb thermometer should register about 65 deg. F.).
   - (*c*) Use no ventilation, but keep the air in the rooms in constant motion by a fan.
   - (*d*) *Add to each room, night and morning, coal gas in the proportion of one part to* 2,000 *parts of air.*
2. *When bananas begin to change colour—*
   - (*a*) Maintain the temperature at 68 deg. F., or reduce a few degrees if it is desired to retard the ripening process, but cease addition of coal gas.
   - (*b*) Reduce the relative humidity to at least 70 per cent. (i.e., wet bulb temperature of not more than 62 deg. F. if the room temperature is kept at 68 deg. F.).
   - (*c*) Ventilate freely by means of a fan.

5. Appliances Suggested.

1. *For Heating.*—Gas has been largely used commercially in the past. This procedure probably introduced some coal gas and its products into the ripening rooms, thus accelerating the ripening. It is considered preferable to use electric heating (radiator units), preferably with some kind of automatic control, and actually to introduce a proper proportion of gas into the rooms.

2. *For Humidifying.*—An effective apparatus for small rooms may be constructed by winding a length of towelling, over horizontal wires on a framework, the whole being kept wet by standing it edgeways in a tray of water. The water can be heated by a radiator placed under the tray, whilst a current of air from a fan playing over the towelling distributes the moisture throughout the room.

For larger rooms, larger humidifiers may be used, or a battery of several small ones. An alternative is to blow in steam from a small boiler as necessary. One containing a small quantity of water fed from a larger vessel and heated by an electric immersion heater would be convenient.

Some types of commercial apparatus are very satisfactory for this purpose, especially for larger rooms.

3. *Ventilation.*—Electric fans may be arranged to cause a discharge of air from a vent when it is necessary to ventilate the rooms.

4. *For determining conditions.*—Wet and dry bulb thermometers.

5. *For regulating the supply of coal gas.*—The simplest way is to ascertain the cubical content of the room and then obtain a vessel approximately 1-2,000th part of such capacity. By inverting the vessel over an open gas jet (not alight) for a few seconds, preferably with a piece of rubber tubing to carry the gas into the vessel, the air in the vessel will be displaced by the coal gas. The vessel can then be covered and the contents liberated in the room. A quicker way, if gas is installed in the room, would be to ascertain the rate of discharge when the tap is open. It could then be turned on for the required period.

6. *For cooling.*—Either an ice box or small automatic refrigerator could be used for small rooms, but for large rooms refrigeration is necessary. Refrigeration cooling may be applied either by running brine pipes through the rooms, or by drawing in cold air from a separate compartment where the air is cooled by brine or ammonia pipes. The cold air procedure is preferable as, if direct piping be used, it would be necessary during the time it is desired to maintain a high humidity, that the pipes should not be much colder than the room, and this would necessitate a large pipe surface. With the air circulation process the piping may be run much colder, thus requiring smaller cooling surface and involving less capital cost.

7. *For humidity reduction.*—This may be effected (especially during humid weather) much better, if refrigeration is available, by removing the humidifiers and using plenty of air dried over the cold refrigerator coils.

Fourth Pacific Science Congress—Java, 1929.

By E. C. Andrews, B.A., F.G.S., Government Geologist of New South Wales.

The following constitutes a report (in slightly condensed form) furnished to the Australian National Research Council for transmission to the Federal Government, by Mr. E. C. Andrews, leader of the Australian delegation to the Pacific Science Congress, held in Java, in May, 1929.—[Ed.]:—

1. Object and History of Pacific Science Congresses.

In view of the growing importance of the Pacific Science Congresses, perhaps a brief statement as to their history and main objects may form a suitable introduction to the present report.

History.—The meeting of the British Association for the Advancement of Science, which was held in Australia during August, 1914, was the occasion for the drafting of plans to organize and co-ordinate scientific research within the Pacific Region. The plans outlined at that time were delayed by the war, but the idea gained ground in the United States, and in 1920 the First Pan-Pacific Scientific Conference was called, the meeting places being Honolulu and Hawaii, and the Conference receiving strong support, financial and otherwise, from the Pan-Pacific Union. Fifty-six (56) delegates attended from Australia, Canada, Japan, New Zealand, the Philippines, and the United States. One of the main features of this Conference was the attempt to stimulate a real geological mapping in the Pacific Region, whereby the main resources of the Pacific might be made known. A Hold-Over Committee was appointed at the close of the Conference, each country being represented by one delegate. In 1922, the Australian delegate was entrusted with the work of calling the second Conference in Australia. Owing to the patronage and the financial support of the Federal and State Governments, and to the sympathetic and excellent response by the National Research Council and other scientific societies and institutions of Australia, the Melbourne-Sydney meeting of 1923 was a magnificent success. Eighty-five eminent scientists and visitors from foreign countries attended, and the results proved so satisfactory that a Committee representing eleven countries was appointed to draft a Constitution and By-laws for a Permanent Organization.

The Japanese, impressed by the success of the Australian Meeting, invited the Congress to visit Japan during 1926. The Third Congress was just as, or even more brilliant and successful than the Australian Meeting in the matter of organization, discussions, and scientific excursions. This Third Congress founded the Pacific Science Association, drew up a Constitution and By-laws, dropped the prefix "Pan," and placed the promotion of scientific work on Pacific problems more in the front.

The members of the Pacific Science Association are the countries which control lands either within, or bordering, the Pacific. The main objects of the Association are:—

(*a*) To initiate and promote co-operation in the study of scientific problems relating to the Pacific Region, more particularly those affecting the prosperity and well-being of the Pacific peoples.

(*b*) To strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientists of all the Pacific countries.

"As a means of attaining these objects, the Association shall organize Pacific Science Congresses."

"The subjects for discussion at Congresses shall include all branches of physical and biological sciences. Their scope, however, shall be so limited as to comply with the conditions specified in Art. 2 of the Constitution."

The Fourth Congress was held in Java during May-June, 1929. A summary of the Congress activities is supplied herewith.

2. Summary of Work of Java Congress.

A. *Personnel of Congress.*

Australia sent nine members and six participants. Of these, the Commonwealth Government was represented by five members, and the Australian National Research Council by seven members.

Names of Delegates.—Mr. E. C. Andrews, Professor A. N. Burkitt, Dr. Constance Ellis, Professor E. J. Goddard, Mr. G. H. Halligan, Dr. I. M. Mackerras, Professor A. R. Radcliffe-Brown, Mr. C. A. Sussmilch, and Professor N. T. M. Wilsmore.

Participants.—Miss Ida A. Brown, Mrs. Burkitt, Miss E. E. Carment, Mrs. Goddard, Mrs. E. Scott, Mr. G. L. Windred.

B. *Extra-Australian Delegates and Participants.*

Countries.	Members.	Overseas Participants.	Countries.	Members.	Overseas Participants.
Austria	..	1	Italy	..	1
Canada	2	..	Japan	39	3
Ceylon	1	..	Macao	1	1
China	20	1	Netherlands ..	25	14
Czecho-Slovakia ..	..	1	Netherlands-Indies ..	23	..
Denmark	1	2	New Zealand ..	2	1
France	2	1	Philippine Islands ..	8	6
Germany	2	6	Siam	2	..
Great Britain ..	3	2	Sweden ..	1	..
Hawaii	4	2	United States of America	28	13
Hong Kong	3	1			
Indo-China	8	4	Total ..	186	66

C. *Address of Welcome by Governor-General of the Netherlands-Indies, and replies.*

The Address of Welcome was delivered in the Law School Hall, at Weltevreden, by His Excellency, Jongheur Dr. A. C. D. De Graeff, the Governor-General of the Netherlands-Indies. His speech, as also the whole of the Congress proceedings, was in English. His Excellency pointed out that the scientists before him were prepared to attempt the solution of the scientific problems of the Pacific "standing aloof from politics and free from national chauvinism and other more or less egotistical motives." He was proud to welcome the scientists "gathered here to work together for the twin cause of Science and Civilization."

The President, Professor O. De Vries, in his opening address, following immediately upon that of the Governor-General, laid stress upon the objects of the Pacific Science Association, upon the events which led up to the formation of the Pacific Science Association, and especially upon the part played by science in promoting harmonious social relations between nations. "Science it is," he said, "that brings us together to-day, and, of all human motive powers, science is undoubtedly one of the foremost in establishing international bonds. Religion, music, the arts, all form powerful ties between human beings, but, with their strong appeal to personality and sentiment, they divide as often as they unite. Science, with its neutral and impartial character, has proved itself far more suitable as a common meeting ground for all peoples."

The leaders of the Delegations from Australia, Canada, China, France, Great Britain, Hawaii, Japan, Netherlands, Netherlands Indies, New Zealand, and the Philippine Islands, made suitable replies to the Addresses of Welcome.

D. *Scientific Programme.*

The work proper of the Fourth Science Congress comprised divisional and joint discussions on scientific problems having a Pacific scope. This more technical portion of the Congress commenced on 18th May, and concluded on 24th May, 1929. For this purpose, the place of meeting was moved from Weltevreden (Batavia) to the Technical Faculty (University) of Bandoeng.

It had been ascertained, at previous Congresses, that the time allotted for scientific discussions did not permit of the individual presentation of all papers prepared. To meet this difficulty, the procedure adopted at Bandoeng consisted of a general presentation, after previous analysis of all papers submitted in time and bearing on a given discussion, by a recognized authority on the subject. Chairmen were appointed also from distinguished delegates. Time was reserved for general discussion after the leader's presentation. The leader would then be expected to co-ordinate the results and frame a resolution, if necessary, to present to the Committee on Recommendations for presentation later to the Pacific Council.

The subjects discussed were agriculture, anthropology, fisheries, forestry, geography, geology, meteorology, oceanography, seismology, volcanology, and wireless telegraphy.

Main interest, from the economic and social view-point, centred round rice cultivation in the Pacific; the cultivation of tea, coffee, coconuts, sugar, cinchona, oil palms, and rubber; plant pests; soil surveys and other soil research work; forestry and timber research; scientific and commercial development of fisheries; weather forecasting; ocean charting, and other problems connected with oceanography; earthquakes and volcanic phenomena; preservation of natural monuments; the improvement of social conditions of native races; and the history of, and relationships between, the various native races of South-eastern Asia.

A copy of the published scientific programme is attached.* The main resolutions arising from this scientific programme dealt with—

(i) the necessity for co-operation "to revise the data given by the Geological Congress at Toronto, in 1913, with regard to the coal resources of these countries."

(ii) "Ensuring a complete international oceanographic survey of the Pacific Ocean" (hydrographical, biological, meteorological, physical, and chemical).

(iii) The study of cross pollination in rice.

(iv) The necessity for soil surveys and soil classification within all Pacific regions.

(v) The problem of land utilization " . . . whereas the problems of food production, population, pressure, and international commerce are closely related to the classification . . . and whereas the Pacific Science Association is more closely related to the physical aspects of these problems than any other international body; be it resolved that the President of this Congress be empowered to appoint the Chairman of a standing committee of the Pacific Science Association to deal with the question of classification and land utilization."

(vi) Estimates of forest resources within the Pacific.

(vii) Pacific economic entomology.

A copy of the whole of the draft resolutions is attached.*

E. *Subjects Considered by the Pacific Science Council.*

The Council is limited in number to fifteen, comprising one representative each from various countries within the Association. Fourteen countries are, at present, included.

A Committee of three was appointed to prepare matters under consideration for presentation to the Council. The Committee consisted of the President, the Leader of the Japanese Delegation, and the Leader of the Australian Delegation. The subjects under reference to the General Council are discussed in the paragraphs that follow:—

(i) An application by France for the admission of French as an alternative language was considered. The main reasons for the adoption of English as the Congress language were summarized by the Japanese and Australian leaders. The result of the deliberations was that the French themselves proposed that English be retained as the language of the Congress.

(ii) *Medical Science.*—The possible advisability of dealing with medical science by associations other than the Pacific Science Council has been stressed recently. (See p. 19, Third Announcement of Java Congress issued May, 1929), but it was pointed out by the Australian Leader, both in the official reply to the Addresses of Welcome, and in the Council itself, that the Constitution specifically states that "all branches of physical and biological sciences" shall be included in so far as they improve the condition of the Pacific peoples. Furthermore, it was pointed out that malaria, dengue, filaria, leprosy, hookworm,

* Not printed.

plague, and so on, have a Pacific distribution in the main, and moreover, that they, together with tuberculosis, venereal disease, and so on, appear to have a Pacific facies, particularly within the Inner Pacific. Climate, also, as affecting the settlement of white races within the Pacific, needed consideration.

(iii) *Agricultural Section.*—In certain quarters, it was thought that agriculture, in common with medical science, might better be left to more local associations. This was reflected in the Third Announcement (p. 19) by the President of the Fourth Congress—

> "Agriculture, therefore, may find it more suitable to organize in the future on another scope, as has already taken place in the case of the medical sciences, which find full satisfaction in the Far Eastern Association of Tropical Medicine. Silviculture which we welcome at our Fourth Congress, where it finds a suitable meeting place, may, or may not, decide to prefer a Pacific above a Far Eastern or a Tropical scope. The veterinary sciences are well on their way to organize on a tropical basis, and do not feel the need to meet at our Congress any more than the medical sciences with their Far Eastern Congresses of which the last three took place in 1923 (Singapore), 1925 (Tokyo), and 1927 (Calcutta)."

It was decided, as in the case of medical science or hygiene, to leave the matter of formation of an Agricultural Section to the Canadian Committee. Nations desiring discussions on these matters are to prepare papers for presentation to the Canadian meeting.

(iv) *Limitation of Number of Delegates to Congresses.*—The increase in the number of delegates, especially of participants, has led to difficulty in the matter of suitable accommodation, especially during excursions.

A tentative scheme was drawn up by the Organization Committee, whereby it was considered advisable to limit the number of delegates to 200, the allotment being as follows:—

> Australia 10, Canada 10, China 10, Netherlands Indies 10, Indo-China 10, Russia 10, Distinguished Visitors 10, Japan 15, United States 25, France 5, Great Britain 5, Holland 5, New Zealand 5, Philippines 5, Straits Settlements and Federated Malay States, 5, Hawaii 5, Siam 3, Hong Kong 2, Macao 1 or 2.

It was considered advisable to allow the wives of delegates to attend.

It was decided to appoint a sub-Committee to deal with this matter, the Committee to consist of the President (Dr. De Vries), together with the Leaders of the Australia, Canadian, Japanese, and United States Delegations. A report will be furnished to the Council for the Canadian meeting.

(v) *Application of Indo-China.*—The application of Indo-China to join the Pacific Science Association was acceded to unanimously by the Council.

(vi) *Places of Meeting of Congresses.*—Invitations to act as host for the Fifth Pacific Science Congress were received from Canada and Indo-China. The Council decided to accept the invitation of Canada for the Fifth Congress (1932). Thereupon Indo-China extended an invitation to the Congress for its Seventh Meeting, in 1935, which was accepted unanimously.

F. *Excursions.*

Numerous excursions were arranged, both before and after the scientific programme. These were excellently conducted, and were designed to supply the delegates with an idea of the potentialities of Java.

3. General Conclusions.

In reviewing the Fourth Pacific Science Congress, several points appear to be worthy of special note.

(*a*) The meeting was attended by many more delegates than any previously held. The Honolulu (Hawaiian) Congress was attended by fifty-six (56) foreigners, the Australian Congress (1923) by 80-85 extra-Australians, the Japanese Meeting (1926) by 142 outsiders, while the Java meeting was attended by 195 foreign delegates and 73 foreign participants. This ever-increasing attendance of distinguished foreign scientists indicates the general success of the Congresses. Their continuance appears to be assured, as shown by the eagerness of Canada and Indo-China to act as hosts for the Fifth and Sixth Congresses respectively.

(*b*) The employment of one language at the Congresses tends to promote a spirit of goodwill between the delegates from the various countries. Incidentally, it may be noted that, during the important excursions, the delegates were received enthusiastically by the governing bodies and by the general public. This feature was particularly marked during the Japanese (1926) and Javanese (1929) Congresses. It would thus appear that the Congresses are powerful instruments in the promotion of harmonious social relations between the various Pacific peoples.

(*c*) The problems of agriculture, anthropology, forestry, fisheries, biology, oceanography, seismology, weather forecasting, and wireless telegraphy, appear to have been approached by the Congress in a manner conducive to the improvement of the material and social conditions of the Pacific peoples. Especially was this noticeable in regard to the cultivation of rice. In this connexion, it may be pointed out that the recent experiments in rice irrigation within the Murrumbidgee area of New South Wales arouse the greatest interest among the authorities on rice cultivation within the Western Pacific.

In oceanography a very valuable contribution was made by Mr. G. H. Halligan. His charts of the Australasian Region, showing the curves for equal temperature, and so on, for the years 1925, 1926, 1927, and 1928, were of very great assistance to the International Oceanographic Committee.

With regard to anthropology, at the Third Pan-Pacific Congress (Tokyo, 1926), a resolution was carried to the effect that—

> "The utilization of anthropological knowledge be made a subject of prime importance for discussion at the next Congress."

As a result, Dr. B. Schrieke, adviser in these matters to the Governor-General of the Netherlands Indies, communicated with those "anthropologists and others who are known to have practical ideas relative to the needs of native peoples, asking them for brief summaries of their views and suggestions as to the more definite utilization of anthropology," and "to make a compilation of these views which shall be distributed among those to whom it may be of interest and value."

Under Dr. Schrieke's editorship, a fine collection of articles dealing with the effect of Western influence on native civilizations in the Malay was published in volume form, and distributed to delegates after the commencement of the scientific programme at Bandoeng. On the other hand, this important publication was expected, especially by the Australian authorities on social anthropology, to have formed the basis of an important discussion at the Congress. Among others, Dr. Radcliffe-Brown, with a knowledge of Australian native races, attended the Congress prepared to contribute to the discussion. From an economic and social point of view, it seems advisable that this discussion of the effect of Western civilization on native races should be emphasized. On the other hand, the magnificent discussions on the sociology and psychology of totemism and the history of the native races of South-eastern Asia aroused intense interest and enthusiasm. Leaders of thought from various countries had assembled in these connexions, and the meeting made history. In the keen debate on totemism, the leaders were Dr. Grafton Elliot Smith and Dr. Radcliffe-Brown. In physical anthropology, contributions were made by Doctors Elliot Smith, A. N. Burkitt, and H. L. Shellshear, all originally Australians.

Professor E. J. Goddard paid special attention to the needs of agriculture in Australia, and Mr. C. A. Sussmilch to geography and geology.

With regard to the subjects of geology and volcanology, there appeared to be lacking, in the excellent discussions provided, a cross-reference to economics. A discussion on a real geological mapping in the Pacific; another on the resources, within the Pacific, of minerals, such as lead-zinc, iron, coal, or oil would have strengthened the geological programme materially. It is expected that an economic side will be provided for at the Canadian Meeting.

(*d*) A matter for regret, from the Australian stand-point, was the absence of a section of hygiene.

(*e*) A most pleasing feature of the Congress was the efficient organization shown by the Executive Committee of Java, and the splendid support, mainly moral, given to its efforts by the Government and Scientific Societies and Institutions of Holland.

The organization, in all ways, was excellent. The President and the other members of the Executive Committee received the 250 guests at the boats, distributed them, and arranged for their accommodation, transport, and their long excursions in an admirable manner. Guide books and other publications, itinerary cards, railway passes, hotel accommodation, were all provided, careful attention being paid to every detail. Moreover, all the published and verbal arrangements were conducted by the hosts in a tongue foreign to them. As with the Japanese in the Congress of 1926, so also in Java, no Hollander ever forgot that the language of the Congresses was English. The consummate tact and skill of the President himself was nowhere better evidenced than in the question of the Congress language when he addressed the Council in a manner such that a distinguished French delegate rose and proposed that English be retained as the language of the Congresses.

(*f*) The question arises as to the advisability or non-advisability of the limitation of the numbers of delegates. It certainly does seem, as in the cases of the Honolulu and Australian Congresses, that the best work is accomplished, from an economic point of view, by the deliberate choice of and extension of invitations to recognized authorities on Pacific problems in natural science. The minimum of effort, with the maximum of efficiency, is thereby secured.

It is a great pleasure to record the very definite contributions to the important discussions by my Australian colleagues. It was a privilege to be associated with so able a delegation.

The Effect of Immature St. John's Wort (Hypericum perforatum) on Sheep.*

By H. R. Seddon, D.V.Sc., and H. G. Belschner, B.V.Sc.†

It is a well established fact that the ingestion of the well-grown or flowering St. John's wort by stock leads to photo-sensitization and consequent dermatitis of the unpigmented portions of the skin.

The effect of the plant is recorded by Cornevin (quoted by Lander (1)), who noted that in Europe mild symptoms of dermatitis might occur, and by Summers (2) in South Australia, who reported that it was said to cause horses which eat it to break out in sores.

The essential feature of the action of the sun's rays seems to have been first appreciated by Rogers (3), who investigated the effect of the plant in 1914. They were confirmed by Dodd (4) in New South Wales in 1920, and also by Henry (5) in 1922, who showed by experiments in which the stock were muzzled that mere contact with the plant did not induce symptoms. We do not know with what stage of the plant Rogers worked, but Dodd used the plant when it was in flower and Henry in the stage immediately preceding flowering.

The question of whether the plant is harmful when in a more immature stage is of some practical importance, for it has been suggested that a possible means of control of the pest would be to graze it when young by sheep or cattle.

Field Investigations.

To determine this point, field investigations were made by one of us (H.G.B.) in the Mudgee district. Several farms, where the plant is growing abundantly, were visited. On the property of Mr. R. a mob of 50 mixed sheep were seen grazing on a 10- to 15-acre paddock heavily infested with St. John's wort in a young stage of growth, and it was estimated that at least 50 per cent. of the available feed

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* Report of co-operative investigations carried out under the aegis of the Poison Plants Committee of the Council. Typescript received 2nd September, 1929.—Ed.

† Officers of the New South Wales Department of Agriculture.—Ed.

consisted of the weed. This was a cultivation paddock, and the sheep had been turned in to eat it down before ploughing commenced. The sheep had been in the paddock about ten days, and had previously come off St. John's wort country. A big percentage of them were exhibiting the typical dermatitis on the nose, face, and ears.

The whole of this farm is more or less infested with the plant, and on walking over the paddocks which had been heavily stocked the young plant was observed everywhere amongst the grass. In conversation, the owner, who has had a number of years' experience with the plant in the Mudgee district, stated that the young growth of the weed is just as dangerous, if not more so, than the old growth, probably because sheep eat more of the plant in the young stage. Stock are always inclined to eat the grass and other herbage before commencing on the St. John's wort, but they will eat the young growth quite readily if there is no grass. The owner was also of the opinion that some sheep eat more of the plant than others do.

A point this owner had noticed particularly was the association of weather conditions with the production of symptoms in sheep, but he stated that though sheep were affected more particularly in the summer time, they became affected at all periods of the year. He well remembered during the summer of a few years ago when a whole mob of lambs were badly affected, with the exception of a black lamb. He stated that the animals were in a pitiable condition.

The property of another owner was visited, and the sheep were found to be affected there. The plant was well distributed all over this farm, and the owner stated that it was impossible to control the pest. It was getting worse every year in spite of cultivation and grazing.

As the result of these investigations one of us (H.G.B.) formed the opinion—

(*a*) that there is undoubted evidence that the plant is harmful in even young stages of growth; and also

(*b*) that grazing the plant when young gives a certain measure of control, but will never eradicate the plant.

Sheep may be left on the plant for a time and will eat a great deal of it off, but when symptoms become severe it is necessary to remove them. Even the repeated changing of the stock would not be likely to eradicate the plant, for its very nature, as exhibited by its deep rooting system and the statement that if the smallest portion is left in the ground it will shoot again, is against close grazing being to any great extent a method of control, and certainly will never eradicate it.

Laboratory Investigations.

In order to determine, by actual feeding experiments, the effect of the young immature plant, supplies were forwarded regularly to the Glenfield Research Station. The plants used were all immature and from 6 to 10 inches high. They were tested by feeding to sheep, when it was found that ingestion set up the usual type of dermatitis, from photo-sensitization, seen in sheep. The symptoms were somewhat delayed in onset, and certainly were not as intense as we have seen in cases induced experimentally in summer, but such, in our opinion, is due largely to the lessened intensity of sunshine during early winter months (when the tests were conducted).

In summer, we have found that in bright warm sunny weather symptoms are induced more readily than when dull, cool, moderately cloudy days occur. During the tests in question the days were sunny for the most part, but lacked the warm sun of summer. Even so, symptoms were noted to be more marked about 2 p.m. on the brighter sunnier, warmer days.

In the absence, as yet, of a definite method of determining the sensitizing properties of the plant (e.g., chemical examination for photo-sensitizing principle) one cannot be positive upon this point, and it is only right here to note that, feeding similar quantities (in summer) of immature and of mature plants, there seems definite evidence that the mature plant is the more harmful. We may state, however, that using the dried mature plant, we have found that, on testing it at different periods of the year, more serious effects are manifested in summer than in winter. One concludes, therefore, that even the young plant is harmful.

Conclusion.

From the above, it will be seen that, owing to the harmful effects of the plant even in the young stages of growth, stock cannot be depastured upon it continually. Heavy stocking with sheep, moving them after a week or ten days, exerts a certain measure of control, but involves much trouble and inconvenience and will not accomplish the eradication of the plant. It does not seem that it is a practicable procedure in a district where bright sunny days are common in the winter. Possibly in a district where the climate is less favorable for the production of dermatitis, i.e., where cloudy winter days are the rule, a greater measure of success might be attained.

Animals with entirely pigmented skins are certainly insensitive to the action of the plant, but the degree to which they would contribute to its control, and the risks from such heavy stocking as would be necessary, do not seem to warrant their employment.

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Enzootic Haematuria of Bovines.

Some Preliminary Observations on the Investigation.

By Campbell G. Dickinson, B.V.Sc., and Lionel B. Bull, D.V.Sc.

The following constitutes an annual report (for the year ended 30th June, 1929) of the investigations being carried out under the aegis of the Council at the Pathological Laboratory of the Adelaide Hospital. This report was submitted to the annual meeting of the full Council which met in September, 1929. The investigations on bovine haematuria were commenced, so far as the Council is concerned, about two years ago, when the authorities of the Laboratory kindly agreed to have the investigations housed at the Laboratory, and also to have them carried out under the direction of the Director, Dr. Lionel B. Bull. The Council appointed Mr. Campbell Dickinson as its investigator, in order that he might undertake the actual experimental work. With the appointment of a chemist to assist them (Mr. Dann), both Mr. Campbell Dickinson and Dr. Bull are now working on a phase of the caseous lymphadenitis problem, in addition to continuing the study of haematuria.—ED.

1. Introduction.

This disease has been known in the Mount Gambier district of South Australia for 50 years or more. Attention was drawn to it by the late Chief Inspector of Stock, Mr. T. H. Williams, when he was stationed in the district in 1894. The same type of disease was present in the Illawarra district of New South Wales for many years, and was investigated by Dr. J. B. Cleland, 1911. It appears to have disappeared from that district in recent years. In other parts of the world, there has been the same tendency for the disease to disappear after some years, particularly with cultivation and improvement of pastures. This observation is, however, not constant, and, in the Mount Gambier district, it would appear that many years ago the disease was more widespread than at present, but in a fairly well-defined area it has manifested itself, with slight fluctuations, over a period of many years.

Hadwen investigated the disease in British Columbia and came to the conclusion that oxaluria was the cause. He made microscopic examinations of the urines and found many calcium oxalate crystals present. He also claimed to have produced the disease experimentally with oxalates. He believed that the crystals of calcium oxalate caused mechanical irritation of the mucous membrane of the bladder with the production of the characteristic lesions, haemangiomata, and papillomata. Observations on the urine from cases of the disease in the Mount Gambier district failed to confirm this finding of Hadwen's, calcium oxalate crystals being rarely met with in the urines examined.

It was thought that possibly an excess of nitrates in the urine might be the cause of the irritation, but chemical examination failed to support this hypothesis.

Soon after this stage had been reached, the present investigation was undertaken. It was necessary to collect as much material as possible for pathological examination, to make a survey to define the limits of

the "red-water" area, to make a botanical survey, and to collect and analyse all the available data on the occurrence, incidence, and distribution of the disease.

In order to accomplish this task one of us (C.G.D.) took up residence in Mount Gambier for some months. Laboratory facilities were granted by the Inspector-General of Hospitals, Dr. B. H. Morris, and the Medical Superintendent of the Mount Gambier Hospital, Dr. Renfrey Burnard. The Chief Inspector of Stock, Mr. C. A. Loxton, granted facilities in permitting the Stock Inspector of the district, Mr. W. H. Wood, to assist in the field work.

Specimens were collected and forwarded to the laboratory in Adelaide. Laboratory work in Mount Gambier was limited to microscopic examination of the urines from cows on "red-water" farms and farms on which "red-water" is claimed to be unknown. Material was collected aseptically at post-mortem examinations and forwarded to Adelaide, where transmission experiments on two cows purchased for the purpose by the Chief Inspector of Stock were carried out. Observations on these experiments are not yet completed. Chemical examinations of the urines had to be deferred and were carried out in Adelaide on our return. These examinations occupied a considerable time. Although it was demonstrated adequately that calcium oxalate crystals were usually not present in the urine, or, if present, only very occasionally and in small numbers, it was not considered that oxalic acid as a possible causative factor had been eliminated. It became necessary to undertake a quantitative analysis for oxalic acid and calcium in the urines of cows on "red-water" and "non-red-water" farms in the Mount Gambier district, as well as from cows outside the district—Adelaide, in this case, being selected. Technical difficulties took much longer to overcome than was anticipated, largely because we are not trained chemists. However, reliable results were obtained in some 165 examinations.

In considering oxalic acid as a possible causative factor, it became necessary to make an examination of plants grown on "red-water" farms and those grown elsewhere in order to determine if a higher proportion of oxalic acid was formed in those from "red-water" farms. Sorrel, *Rumex acetosella*, was taken as the test plant, and specimens were collected from Mount Gambier, Kybybolite and the Hills district of Adelaide. Bracken fern, *Pteridium aquilinum*, a common plant in the district, was also analysed for oxalic acid. The estimation of oxalic acid in the plant proved difficult, but, with the approval of Professors A. E. V. Richardson and J. A. Prescott of the Waite Agricultural Research Institute, Mr. R. E. Shapter, research chemist of the Council for Scientific and Industrial Research attached to that Institute, overcame the difficulties for us and the examinations were completed satisfactorily.

A great amount of material and data have been collected but have not been completely worked up at present.

A considerable amount of chemical work still remains to be done before the experimental production of the disease can be reasonably

attempted. Steps have been taken to continue with this chemical investigation, and Mr. A. T. Dann, M.Sc., has recently been appointed for the purpose.

It is not possible to make any detailed statement of the results of the investigation at this time, but certain matters may be briefly referred to.

2. Clinical Diagnosis and Survey.

An animal suffering from enzootic haematuria is observed to pass bloody urine from time to time. The amount of blood present in the urine varies very considerably, and animals may pass small amounts of blood in the urine without attracting the attention of the owner or attendant. The haemorrhage from the lesions in the bladder mucosa is accidental. Some small and insignificant lesions may lead to severe or fatal haemorrhages, while larger or more extensive lesions may bleed very little. The clinical diagnosis is uncertain, for an examination of the urine from an affected animal at any one time may fail to show the presence of blood, either macroscopically or microscopically. A cystoscopic examination would give more exact information, but it is not possible to carry out such an examination in the field. Under these circumstances, one is unable to obtain exact information as to the number of animals in a herd that are affected, nor is it possible definitely to exclude the presence of the disease in any herd. Microscopic examinations of the urine have revealed the fact that many animals in a herd on a "red-water" farm are passing small quantities of blood in the urine, and sometimes much larger quantities, when there has been no suspicion on the part of the owner that such animals were abnormal.

These facts have to be taken into consideration in the evaluation and interpretation of information obtained from dairy farmers. They also place a limit on the exactitude of making a determination of the distribution and incidence of the disease.

During a residence of three months in the Mount Gambier district, a general survey of the district was made from the point of view of distribution and incidence of the disease, classes of soil on which it occurs, class of herbage on which the animals graze, source of water supplied to the stock and methods of farming adopted (use of manures, cultivation, &c.).

The districts visited covered an area extending approximately 36 miles from north to south and 24 miles from east to west, and 155 farms were visited, each farmer being asked a series of questions on the subject.

It was found that haematuria was most prevalent within the immediate vicinity of Mount Schank and within a radius of some 6 to 8 miles of Mount Gambier. On one farm at Millel, 2 miles north of Mount Gambier, the disease has been prevalent for 30 years, with the exception of ten years (1907-1917), during which period no cases occurred. During the ten years' freedom from the disease, the stock were given rock salt, but later refused to take it. This farm is separated by a road from a farm on which the disease is alleged to have never made its appearance.

On one road at the base of Mount Gambier, the farms (all small holdings) that extend up on to the mountain side all have histories of red-water, while the farms on the other side of the road, which extend down to the flat, are said to have been always free from the disease.

A somewhat similar state of affairs exists in the Mount Schank district. The farms which encircle the base of the mountain (an extinct volcano) all have red-water more or less continuously present, while other farms farther away on the flats are said to be free from the disease. One man reports having run his herd of about twenty head for twenty years on country on the flats without having had any cases. In 1922, he leased a paddock of 16 acres close to the foot of the mountain and in the following five years he had three cases of red-water. This paddock was without any water supply and the cows grazed there only during the day-time, being taken home at evening and given water from the supply that they had always had. This leased paddock had not been ploughed for some years, and was heavily overgrown with ferns and sorrel, though there was also a good growth of clovers.

A similar instance was reported by another farmer some 4 miles east of Mount Gambier who had a herd varying from 12 to 28. His own farm was cultivated with manures in rotation, and he leased a paddock close by, which he described as "stale and ferny" and which had not been ploughed for years. While he leased that paddock he had six cases of red-water, and he has had no further cases since he gave it up. The water supplied to stock was found to be derived from water-holes, bores, and the town water supply from the Blue Lake.

Botanical surveys were carried out on three farms known to be affected with red-water—two that were said to be free from the disease and one doubtful one. Mr. E. S. Alcock, of the South Australian Department of Agriculture, kindly assisted in this work and no marked difference in herbage was found.

3. The Character of the Soil.

It has been found that "red-water" occurs chiefly on those farms situated about the old volcanoes, Mount Gambier and Mount Schank. In the past, it was also very common on farms and stations situated some miles from these mountains, such as at Glencoe, some 15 miles west of Mount Gambier. Even at present, the disease is found on some farms outside the influence of the old volcanoes.

Recently, Professor J. A. Prescott has carried out some investigation on the soils of the Mount Gambier district. He and Mr. C. S. Piper communicated the results of their investigation to the Royal Society of South Australia on 11th July.

The soils of the district are characterized by having a high proportion of coarse and fine sand and a low proportion of clay. They are also rich in phosphoric acid and in spite of the relatively high rainfall are on the alkaline side of neutrality for the most part. Those soils in the vicinity of Mount Gambier, covering an area of approximately 25 square miles, contain volcanic ash which has a high proportion of calcium carbonate. The general outline of the ash deposits has been described by Dr. C. Fenner but the exact boundary has not yet been determined.

We may summarize the data collected by saying that "red-water" has been common in the Mount Gambier district within a radius of about 15 miles of the town; the "red-water" area has contracted to within a

few miles of the town and the disease is now seen mainly in cows on the soils containing volcanic ash. Outside this area of ash deposit, "red-water" farms do occur, but for the most part these are characterized by being rough, ferny and uncultivated. This suggests that some physical or chemical factors in the soil are closely associated with the occurrence of the disease, and that improvement in the pastures by cultivation and manuring have counteracted the influence of these factors except in those areas characterized by the presence of volcanic ash.

It has been found by Mr. G. Samuel and Mr. C. S. Piper that manganese deficiency of oats is common in the same soils that are associated with the presence of "red-water" in cattle. A lower manganese content is found in the pasture grasses and herbage than occurs in the same plants grown elsewhere. No investigation of this association of manganese deficiency in plants and "red-water" in cattle has been made up to the present. The soil contains manganese in normal amounts and the pasturage contains less than is found in other parts. Nothing is known of the manganese requirements of the animal. The animals, however, are obtaining manganese both from the pasturage and the soil contaminating it. If "red-water" is associated with a low manganese intake, then the manganese requirements of the milking cow must be much higher than one might anticipate. This subject is to receive more attention in the near future.

4. Urine Analysis and Oxalic Acid.

In spite of the fact that microscopic examinations of the urine from cows on farms where "red-water" has been known for years have failed to reveal the presence of calcium oxalate crystals in any appreciable number of instances, or in any appreciable amount, it has been considered advisable to investigate the possibility of oxalic acid playing a part in the production of the disease as thoroughly as possible. The oxalic acid present in the urine may be exogenous or endogenous. If it is exogenous, it must result from the ingestion of plants containing relatively large quantities of it. If it is endogenous, it probably results from some disturbance of the metabolism of the animal. Oxalic acid is poisonous or irritating to animal tissues in so far as it robs the cells of calcium. Calcium oxalate appears to be inert and it is doubtful if the crystals are capable of mechanically injuring a tissue to the extent suggested by Hadwen. Oxalic acid may be present in the urine in the absence of any calcium oxalate crystals. If the oxalic acid present is not all combined with calcium it would be active and irritating to the tissues of the bladder, as the urine remains in contact with the mucosa of the bladder for a relatively long time.

If oxalic acid be found in excess of the amount required to combine with calcium to form calcium oxalate, it is assumed that so much oxalic acid exists in an active form and might cause changes in the tissues if they are subjected to such an irritation over any length of time.

A total of 165 samples of urine has been quantitatively analysed for oxalic acid and for calcium. These were taken from herds which may be divided into four classes.

1. Herds on two farms in Mount Gambier known to be affected with "red-water." Ninety-five samples from 55 cows were examined. Eleven of those (11.5 per cent.) showed an excess of oxalic acid over the amount of calcium necessary to form calcium oxalate.

2. Herds on two farms in Mount Gambier which are allegedly free from "red-water." Thirteen samples from thirteen cows were examined and one (7.7 per cent.) showed an excess of oxalic acid.

3. Herds on two farms outside the Mount Gambier district and within a few miles of Adelaide. These two farms were selected as the animals were grazing on pastures containing an abundant growth of soursobs, *Oxalis cernua*, a plant known to contain much oxalic acid. The plant is present usually for about three months of the year. Eighteen samples from eighteen cows were examined and two (11.1 per cent.) showed an excess of oxalic acid. The two animals were both present in the one herd of seven, giving a figure for the one herd of 28.5 per cent.

4. Herds from two farms within a few miles of Adelaide, but where no plant containing a large quantity of oxalic acid was being consumed as far as could be determined. Thirty-nine samples from 39 cows were examined and three (7.7 per cent.) showed an excess of oxalic acid. The three animals were all present in the one herd of eleven, giving a figure for that herd of 27.2 per cent.

These results are equivocal and there remains much to be done before a decision can be reached.

The results of the analysis of sorrel and bracken fern are as follows:—

	Oxalic Acid.	
	Sorrel.	Bracken Fern.
	%	%
"Redwater Farm" 1	2·94	0·31
"Redwater Farm" 2	3·76	0·26
Kybybolite	2·2	0·15
Adelaide Hills	4·46	..

5. Histopathological Examinations.

A histopathological examination has shown that the lesions are essentially the same as those found in other parts of the world. In a proportion of the chronic cases, cancer (epithelioma) has been found to have developed.

Specimens have been obtained at post-mortem examinations on known cases of "red-water" and also from butchers in Mount Gambier, mostly from beasts not known to be affected with the disease. In all, 32 bladders from Mount Gambier have been examined microscopically and 23 of these showed frank manifestations of the disease. By arrangement with some of the local butchers in Mount Gambier, inspections were made of bladders from cattle killed at their slaughter-houses, a total of 78 thus being seen. Of these, four showed typical "red-water" lesions and were submitted to microscopic examination.

Bladders were obtained from cows on "clean" farms and five of these were submitted to microscopic examination. In addition, seventeen bladders from sheep were similarly examined.

For purposes of comparison the bladders from eleven cows and eight bullocks killed at the Metropolitan Abattoirs, Adelaide, were submitted to microscopic examination.

Very valuable information has been obtained from these examinations. The whole of this material has not been thoroughly worked up at present.

It is proposed that the results of this investigation will be made available for publication from time to time, when full details will be given and their significance discussed.

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The Commonwealth Research Station, Merbein.—Annual Report.

By A. V. Lyon, M.Agr.Sc., Officer-in-charge.

The Commonwealth Research Station, Merbein, is concentrating on problems of the production of currants and raisins when grown under irrigation. The Station was originally under the control of the Mildura Vineyards Protection Board, but it was passed over to the Council by that body shortly after the Council's establishment in 1926. The area of the Station is 86 acres, most of it being irrigable. This land was provided by the Victorian State Rivers and Water Supply Commission. The following is a brief annual report which was submitted to the September, 1929, meeting of the full Council.—ED.

1. General.

The season provided very suitable conditions for growth and fruiting of vines, and for the drying of the products. There was no occurrence of moist and wet weather conducive to development of fungus diseases, and, excepting Oidium, which appears annually, no vine diseases were noted throughout the year. The yield of grapes on the Station was very satisfactory, and the quality of the dried products excellent.

2. Viticulture.

The yield and the weight of prunings have been recorded on each of approximately 600 vines. These data have been employed in determining individual variation, in order to ascertain the number of vines necessary in each experimental plot to give results of statistical reliability. The correlation between wood growth and yield has also been obtained.

The relation between the size of the fruiting shoot and the bunch borne thereon has been determined. Results show, in the case of the Zante currant, that the size and quality of the berries and the total weight of the bunch show a direct correlation with the size of the shoot on which the bunch is borne. In the case of the sultana, this correlation is less in evidence.

An investigation of two common practices of treating "frosted" vines has been concluded. The vines were treated soon after frosting in October, the canes being shortened, and alternately totally disbudded. The results showed no significant differences in yield compared with untreated controls in either of two successive years. The yield in the season following frosting was satisfactory in all respects.

The fruiting habit of the sultana is being studied in detail. This work comprises a record of the position at which dormant buds, barren shoots, and fruiting shoots occur, and the relative proportion of each.

This work is correlated with the various types of canes which normally occur under standard district practice. The results are very consistent, and indicate that modification of present pruning practice is warranted.

Measurement of growth of the shoot and the berries has been taken at regular intervals, and presented as "growth curves."

Pruning reactions have been studied for determination of the relation between the reduction of annual wood by pruning, and the total amount and the quality of the subsequent crop. The effects of disbudding barren shoots in early spring and restricting the bearing cane by twisting have also been recorded. Results indicate that the present practice of pruning to a constant number of canes, irrespective of the amount of annual growth of the previous year, is faulty in principle. Disbudding gave no significant differences during the first year. The practice of restricting canes showed to advantage over those loosely tied down, both in yield and shoot development.

Yield analyses have been continued, and the data obtained now include—

(*a*) Sprouting percentages, taken at each bud on the bearing canes.

(*b*) Flower and berry counts, for determination of the "setting" percentage.

(*c*) Proportion of fruiting and barren shoots and dormant buds, taken positionally.

(*d*) Total yield and characteristics of the fruit, embracing size, sugar-content, and general quality.

It is expected that complete analyses of this type will become important in a detailed examination of the results of field experiments.

3. Root Studies.

Excavations for a study of the permanent root system of sultana and Zante currant vines have been made, and the horizontal and vertical distribution shown in maps and photographs. The study of the vertical distribution has been extended to district vineyards, in order to correlate vertical distribution with soil type.

The annual root development has been studied in detail, and extensions mapped at regular seasonal intervals and in relation to irrigation. Study of the mycorrhiza associated with vine roots and the absorbtive mechanism generally is in progress. Results show that the main permanent root system is established below the depth at which the land is normally worked, and that the secondary system, formed in an upper zone, is frequently damaged by tillage implements, apparently without detriment. The most striking feature of the detailed examination of the smaller roots and the absorbtive mechanism was an almost entire absence of root hairs and the invariable presence of mycorrhiza.

4. Bud Development.

Specimens of buds were taken at regular periods throughout the year, and used in a microscopic examination of the development of the rudimentary inflorescence. Permanent preparations, taken seasonally and positionally, have been preserved for comparison with bud development in future years.

5. Ecological Survey.

A detailed botanical map has been completed in connexion with an ecological survey of about 26 acres of virgin land, on which additional field experiments are to be undertaken.

A soil survey is at present in progress. Soil examination include the profile to depth of 16 feet at 5-chain intervals, and the chlorine and total soluble salts of samples taken in vertical section every 6 inches.

The data have been studied for determination of points at which more intensive analyses are necessary in order accurately to locate soil changes which may occur under irrigation.

6. Irrigation.

Profiles showing the extent of the percolation of water from an irrigation furrow have been prepared. The data embrace the following information in regard to each of five soil types:—

(*a*) Shape and size of the percolation profile at various time periods.

(*b*) The quantity of water used.

(*c*) Changes in the rate soakage.

(*d*) The soil profile and soil characteristics.

A study of community irrigation, embracing the frequency of, and the season for, application of water, has been continued. The relation of seasonal irrigation to critical periods in the development of the vine is included.

The Station is co-operating with the settlers and with officials of the State Rivers and Water Supply Commission in initiating improvements in the community system at three Victorian settlements (Nyah, Red Cliffs, and Merbein).

7. Sulphuring Stone Fruits.

Determinations of the sulphur-dioxide content of dried stone fruits, apricots, peaches, and nectarines disclosed that portion of the new season's pack of these fruits contained more than the allowed amount (14 grains per lb.) of sulphur dioxide. Subsequent examinations by the Customs Department showed that the major portion of the Australian pack was over-sulphured.

A study of the plants used and the methods employed by the growers was made, and the problems associated with sulphuring stone fruits have been defined. Laboratory trials were undertaken to determine the extent to which oxidation of the sulphites by two reagents (chlorine as hypochloride and hydrogen peroxide) was possible.

Arrangements have been made to continue experiments in the coming season, the Station forming a unit, in conjunction with the States concerned, in a series of investigations designed to cover the more urgent problems.*

* See this *Journal*, Volume 2, No. 3, p. 151.

8. Dried Fruit Pests.

The Showell process and the Maxol process, designed for prevention of infestation of dried fruits by dried-fruit pests, have been investigated and reports submitted.

The efficacy of the ethylene dichloride-carbon tetrachloride method of fumigation for dried-fruit pests was tested, and a report submitted. Semi-commercial trials indicate that the fumigant is more efficient than those in present use in Australia.

During the year a visit to the Station was made by Mr. G. F. Hill, of the Division of Economic Entomology, and arrangements made for co-ordinated investigations, particularly in the direction of securing insect-proof packages, and in continuing surveys to determine the extent of the occurrence of the principal pests at critical periods of the year. Concurrently with this survey, assistance will be given to the inspectorial staff of the Department of Markets and Transport in its endeavour to improve the hygienic conditions of packing houses and to decrease sources of infestation.

Committee of Control.

The staff gratefully acknowledges the assistance received from the Committee of Control, consisting of Dr. B. T. Dickson, Chief, Division of Economic Botany (Chairman); Professor J. A. Prescott, Chief, Division of Soils; and Professor T. G. B. Osborn, the Botany School, Sydney University.

NOTES.

Back Numbers of Periodicals.

With the extension of its activities, the Council is frequently faced with a shortage of literature with which to assist its more isolated groups of investigators and individual research workers. It is difficult to overcome this comparative isolation, for many of the problems under investigation need study in the localities in which they occur. Climatic factors also exert an effect. It has become quite obvious that the scientific staff of the Council can never be located all in one central place if efficient work is to be carried out in all branches.

To meet that position so far as literature is concerned, it is proposed, *inter alia*, to build up duplicate sets of all periodicals of scientific interest published in Australia. Gifts of copies of the publications (including journals) of the State Departments of Agriculture, of the Linnean Society of New South Wales, of the Royal Societies in each State and of the State museums, more particularly the early issues, would be much appreciated. If any reader, who has any such publications that he would like to present to the Council, either single volumes or sets running over a number of years, would communicate with the librarian of the council, arrangements would gladly be made for their cartage, &c.

A Disease of Coconuts—Visit of Dr. H. R. Angell to Papua.

At the request of the Papuan authorities concerned, Dr. H. R. Angell, of the Division of Economic Botany of the Council, recently paid a visit to Papua for the purpose of investigating a disease of coconuts which had been reported to be serious in the vicinity of Port Moresby. He reached Papua on 4th August, and returned to Australia on the 18th February.

As to the symptoms of the condition, trees in an advanced stage of the disease are readily detected by the greatly reduced number of fronds or leaves. In extreme cases, only three or four of the youngest remain alive; all the others break down prematurely at the junction with the stem or at a few feet from it. Trees in less advanced stages of the disease may, in spite of having about the average number of leaves, betray its presence by the abnormally yellow colour of the foliage and by the breaking of the midribs of certain leaves at any point from 2 to 3 feet from the tip to the junction with the stem.

The trouble is of considerable economic importance, since the value of a coconut palm at bearing age is about £1. The disease is thus liable in the course of a few years to result in the loss of tens of thousands of pounds of capital.

Dr. Angell has been able to make tentative suggestions for control based on clean cultivation, on the use of compounds of sulphur and copper, and on the use of lime. Cultures of the organism isolated from the leaves, and therefore in all probability responsible for the condition, are now being studied in the laboratory.

The Red Legged Earth Mite in Western Australia.

(*Penthaleus destructor,* Jack.)

The chief of the Division of Economic Entomology (Dr. R. J. Tillyard) has recently returned from a visit to Western Australia, where among other things he inquired into the possibilities of investigations relating to the possible biological control of the red-legged earth mite, which is rapidly becoming a serious pest in that State. The following information is based on a report which he furnished to the Council on his return.

The pest belongs to the family Eupodidae of the order Acarina, class Arachnida, and was introduced from South Africa to Bunbury in 1917. Since then it has spread far and wide in Western Australia. Owing to the fact that it is not an insect, and that it belongs to a family of which most of the members are known to be predaceous, it enjoys, as far as at present known, a complete immunity from natural enemies. Further, as it has become in Western Australia entirely a winter pest, it is not very likely that any natural enemy when discovered will be able to control it unless an enemy can be found which will also work in the winter. After having studied the pest and seen its depredations at the end of its active season, both in the south-west around Bunbury and Harvey, and also in the nearer wheat belt at York and Beverley, Dr. Tillyard has come to the conclusion that it is a serious menace to the future of Australian agriculture, and that its spread to the eastern States of the Commonwealth might easily result in the most disastrous consequences.

The eggs of the mite are laid in soil crevices shortly after the onset of the first warm weather in spring. They lie dormant through the summer until the autumn rains occur in May, when they hatch. Winter eggs are laid on the foliage of plants, and numerous generations succeed one another from May to September. The favorite food of the mite appears to be Cape weed and subterranean clover, but it will also attack many other plants, both weeds and garden vegetables, particularly severe damage having been noted on lettuce, late potatoes and peas, and also on a number of garden flowers, including carnations.

Parasitic Gastro-Enteritis in Sheep.

For some time past, Dr. Clunies Ross (an officer of the Council stationed at the University of Sydney) and Dr. H. R. Seddon, of the New South Wales Department of Agriculture, have been co-operating in the study of gastro-enteritis in sheep due to parasites. It has been observed in the southern Australian States that infestation of sheep with smaller Trichostrongyles, *Ostertagia sp.* and *Trichostrongylus spp.* appears to be more constant than that with *Haemonchus contortus.* In view of reports published in other countries of the relative inefficiency of the anthelmintics in common use for removing these parasites, it appeared advisable to the investigators to carry out tests of a wide range of anthelmintics against them, in view of the possibility of the parasites proving of increasing pathogenic importance in Australia. During the course of the experiments, it was found desirable to include tests against *H. contortus* of the efficiency of anthelmintics

selected as a result of the earlier tests for this parasite, which while less constant in its incidence in the south, is still the parasite of greatest importance as the cause of parasitic gastritis in at least New South Wales and Queensland.

The investigators have now furnished a report on their work, and arrangements have been made for its publication by the New South Wales Department of Agriculture. During the course of the work, tests were carried out with a number of drugs, including copper sulphate, mustard, carbon tetrachloride, carbolic acid, iodine, sulphates of barium, iron and other metals, lead arsenate and various other mineral salts, chloral hydrate, toluol, tetrachlorethylene, and others. As a result of the work, it is concluded that the most useful drugs with which to combat troubles caused by worms in sheep are (*a*) copper sulphate, (*b*) copper sulphate and mustard, (*c*) carbon tetrachloride, and (*d*) tetrachlorethylene. The investigators point out that no drug tested will remove, by a single dose, all of any species of worm in every individual animal, and mainly for this reason severely infested animals should receive at least two treatments. They also draw attention to the fact that where sheep are badly parasitized, the pastures will be infected and considerable reinfestation is likely to occur if one treatment only is given.

The Export of Frozen Mutton—Scientific Expedition.

The authorities of the British Food Investigation Board and others have recently decided to carry out some investigations with a view to the possible improvement of the condition—particularly the "bloom"—in which frozen lamb and mutton arrives on the London market. The proposed work was suggested by New Zealand authorities, from which Dominion the export trade in mutton and lamb reaches very considerable proportions. It has been stated that frozen lamb is frequently landed on the London market with defective bloom, leading to a decrease in its market value sometimes by as much as ½d. per lb.

The loss of bloom of frozen mutton involves all three external constituents of the carcass—the exposed muscle, the surface connexion tissue of "skin," and the fat. The changes in these constituents that take place after freezing and storage will depend largely on the temperature, the relative humidity, and the rate of movement of the surrounding air in each stage of the storage chain. Another factor is the rate of cooling of the surface layers. All these factors will, in addition, affect the rate of loss of weight of the carcasses. The keeping qualities of the fat may also be affected by light. As an essential preliminary to the investigations, a survey is to be made of the actual conditions under which lamb and mutton is exported from New Zealand from the earliest stage on the farm to the final market in England. The survey will be carried out by officers of the British Food Investigation Board, assisted by officers of the national research organizations of New Zealand and Australia. The officer in charge of the survey is Dr. Ezer Griffiths, and the others participating in the work are Mr. Haddow, Dr. J. R. Vickery, Mr. N. E. Holmes, and an officer to be attached by the New Zealand Department of Scientific and Industrial Research. Of the above, Dr. Griffiths and Mr. Haddow are officers of the British Department of Scientific and

Industrial Research (of which the Food Board is a part), and Dr. Vickery and Mr. Holmes are officers of the Council, the former having recently spent three years at the Cambridge Low Temperature Station of the Board as an 1851 exhibitioner.

After making a thorough survey of the conditions under which the trade operates on land prior to the shipment of the meat, the members of the expedition will proceed to England on two or three separate boats carrying cargoes of mutton, and will continue their measurements of the temperatures, humidity, &c., of the holds at sea. Similar work will be continued in England on the arrival of the shipments. The expedition commenced its inquiries in New Zealand early in November, 1929.

The results of the work will naturally be of considerable benefit to Australia. In addition, the investigation will serve as a means of training at least two Australians in the methods of cold storage research work. The services of these two investigators will subsequently be of value in connexion with the export from Australia, not only of meat, but of other perishable food products as well.

Investigations on "Braxy-like" Disease in Western Australia.

In a previous issue (May, 1929), a brief note dealing with the braxy-like disease of sheep in Western Australia was given. Since that time, arrangements have been made for the initiation of a larger programme of work on the problem.

The new investigations will be a joint enterprise of the Western Australian Department of Agriculture and the Council. The suggestions for the work were originally made by Mr. H. W. Bennetts, who has been investigating the disease for some time, and they were then considered by the State Committee of the Council, of which Mr. G. L. Sutton, the Director of the Department of Agriculture, is a member.

The Department has agreed to make available valuable facilities at the Avondale State Farm, which is situated at Beverley in the affected area. In addition, it has undertaken to see that the whole policy of the farm, cropping, &c., will be altered in accordance with the requirements of the investigations; to make 1,000 sheep available for the work; to provide £500 for the erection of a small field laboratory; and to make the services of some of its officers available in a consultant capacity, more particularly on the soil, chemical and botanical sides. It has also agreed to continue to allow Mr. Bennetts, who is one of its officers, to remain with the Council.

The Council has agreed to provide £500 for laboratory equipment; to provide the services of a chemist at a salary of £400 per annum; to continue to make the services of Mr. R. Harley, M.R.C.V.S., available; and to continue to pay the salary of Mr. Bennetts.

In order to advise generally on the carrying out of the work, a small advisory committee has been appointed, consisting of Mr. G. L. Sutton, Mr. B. Perry (chairman of the Western Australian State Committee of the Council), and Mr. H. W. Bennetts. It has also been arranged that Mr. Bennetts will visit the eastern States at an early date, and consult there with Professor Brailsford Robertson on nutritional aspects of the problem, and with Professor Woodruff on the pathological aspects.

The cause of death in sheep which die from the disease is toxaemia, resulting from *Bacillus welchii* proliferation in the small intestine contents with the production of a high concentration of toxin. The enlarged programme will cover such matters as—

(*a*) The factors predisposing to *B. welchii* proliferation—(i) soil conditions favouring heavy contamination with the bacillus, and (ii) the nature of the feed favouring *B. welchii* in the small intestine of sheep.

(*b*) The question of naturally acquired flock immunity of which there is some evidence.

(*c*) The artificial reproduction of the disease per the mouth by feeding sheep under stall conditions with various rations and synchronizing with drenching with cultures of *B. welchii*.

(*d*) The production of a vaccine which may be used as a prophylactic measure against the bacillus.

Experiments on the Preservation of Fence Posts.

The supply of durable timbers for fence posts is being rapidly exhausted in many parts of the wheat belt in Western Australia, and farmers are being forced to use salmon gum, gimlet, and other species which have a very limited life if placed in the ground without any preservative treatment. At the present time, however, little is known as to the most satisfactory and economical method of preservation for these particular timbers.

The Forests Department of Western Australia has interested itself in the problem of the development of such a method, and has recently arranged with the Council for an investigation to be commenced this summer. The work will be under the immediate supervision of Mr. J. E. Cummins, now an officer of the Division of Forest Products Research of the Council, but formerly an officer of the Western Australian Department. While with the Department Mr. Cummins paid particular attention to the preservation of timbers, and his experience in that branch of work was enlarged during his recent two years' sojourn at the Forest Products Laboratory, Madison, United States of America, as a trainee under the Science and Industry Endowment Act.

The proposed investigations will be a co-operative enterprise, the Forests Department having arranged to supply the necessary timber, preservative materials, and labour, and the Council the services of Mr. Cummins. The work will be carried out at the State Sawmills, Pemberton, and will consist in the treatment of posts of salmon gum, gimlet, &c., in various ways. The work is also being extended to thinnings of jarrah and *Pinus radiata* (*insignis*). The first method to be tried will be creosoting and fluarizing (involving the use of sodium fluoride and arsenic).

Some preliminary tests with green salmon gum, Goldfield's red gum, and brown mallet showed that an excellent sapwood penetration could be obtained by a treatment of four hours' boiling, and subsequent cooling in the solution. The absorption, however, was not sufficient. A further supply of posts is now being seasoned for tests on timber in that condition.

It is believed that the information that will be obtained as a result of the work outlined above, will be of value, not only to farmers in Western Australia, but to those of Australia as a whole.

The Composition of Pastures.*

The recent publication of the Empire Marketing Board on the composition of pastures, which is a review of the most recently acquired knowledge of nutrition as applied to problems connected with the feeding value of pastures, is of considerable importance, particularly in those countries, such as Australia, where the pastoral industry has reached large proportions. The paragraphs that follow form a brief abstract of some aspect of the matters discussed in the memorandum.

Co-operation in pasture research throughout the Empire has been secured largely through the instrumentality of a sub-Committee of the Committee of Civil Research. The Empire Marketing Board has also interested itself in the matter, and has granted valuable financial assistance to investigations of this nature being carried out as a part of a general co-ordinated scheme. As a result of these activities, information from different branches of science is being brought to bear on the problem of the increased production of grasslands. There is a continuity of effort and a free and informal exchange of information between the workers and the institutions in different parts of the Empire, and it has already been found that information obtained perhaps incidentally in one part of the Empire, has an important bearing on the problem of another. Thus work on iodine deficiency in Canada is throwing light on the problem of goitre in Australia and New Zealand, and the work of the Waite Institute in Adelaide on the transpiration (or "breathing") of plants growing on different types of soil is yielding information which is being considered in connexion with the improvement of pasture lands in the semi-arid parts of Africa.

Recent research in pastures has been largely influenced by developments in the knowledge of the food requirements of animals, and, since the war, there has been a vast amount of work done to determine to what extent essential food constituents—other than proteins, fats, and carbohydrates—are present in different foodstuffs, and the effect of a deficiency of them on the health and rate of growth of animals. Vitamins and mineral elements and combinations, such as phosphoric acid, lime, potash, &c., are the two constituents on which attention has chiefly been focussed. It has been found that pastures, like other green foodstuffs, are comparatively rich in vitamins, and, as far as is known at present, they contain no shortage of these food factors. Thus, on the whole, the vitamin content of pastures is of less immediate practical importance than the content of minerals and proteins.

One approach to the problem of the most suitable composition of pastures is to consider that of milk, which can be taken as the food of ideal composition for growing animals. It has been found that a comparison of the chemical composition of good pasture and cows' milk will show a fairly close resemblance between the mineral and protein content of the two, and that, as pastures are improved, the chemical compositions tend to approximate more and more closely. Hence, really good pastures, from whatever part of the world, tend to have a somewhat similar composition. Uncultivated or natural herbage differs from cultivated, in being, in general, poorer in mineral elements, and to a lesser extent poorer in proteins.

* The Composition of Pastures; by J. B. Orr, D.S.O., M.C., M.A., M.D., D.Sc., Director of the Rowet Research Institute, Aberdeen. Empire Marketing Board, No. 18, June, 1929.

Another important point is that the modern improved breeds of rapidly maturing cattle have been evolved in localities where improved and cultivated pastures are the rule. Many sires of these breeds have been imported into the newer countries to improve the native cattle, but in many cases due attention has not been correspondingly paid to the pastures, with the result that the equilibrium between the grazing animal and the herbage is upset. The resulting mortality and sterility is a natural process, tending to the elimination of the type whose rate of growth and reproduction is greater than the herbage can support.

The diseases, such as bone-chewing, rickets, styfsiekte, &c., due to mineral deficiences in the pastures, are discussed in the memorandum at some length. It is pointed out that the most usual forms of these conditions are due to a deficiency in phosphorus or calcium, but the probable effects of lack of iron in producing the "bush sickness" of New Zealand and of iodine in enlarging the thyroid gland of animals are also mentioned. The results of the experiments being carried out on deficiency diseases all indicate that disease is the extreme effect of the deficiency. There may be a degree of deficiency, however, which, while not sufficient to cause disease, limits the rate of growth and the production of the values—meat, wool, milk, &c.—being exploited. There are also indications that these minor deficiencies may, by lowering the natural resistance of animals, predispose them to other diseases.

The factors on which the chemical composition of pastures depend are discussed under—(i) species of plans, (ii) seasonal variation and stage of growth, (iii) climatic conditions and composition, and (iv) the soil. Different species of plants show natural differences in mineral composition, even when grown on the same soil and under the same climatic conditions. Thus legumes tend to be richer in both proteins and minerals, especially calcium, than grasses, and the grasses are richer in phosphorus. Valuable work is being done in improving strains, and in finding or breeding new types of plants more suitable for different districts or different climates.

As regards the effect of seasonal variations, it is well known that the amount of sunshine, the temperature, and the rainfall all alike affect the rate of growth and the rate of transpiration, and that the latter has an influence on the amounts of salts in solution absorbed by the plant. Thus droughts seriously reduce the amount of phosphorus absorbed by the herbage, and this is quite possibly one reason for deficiency diseases being so prevalent in periods of poor rainfall.

After a discussion of the merits of top-dressing with mineral fertilizers, mention is made of, firstly, the gradual improverishment through the removal of animals and animal products if no compensating return is made to the soil; and, secondly, of an estimate by Professor A. E. V. Richardson, that the soils of Victoria have been depleted to the extent of 360,000 tons of phosphoric acid during the last 60 years by the export of plant and animal products, and that nearly 2,000,000 tons of superphosphate would need to be added to restore them to the condition they were in in about the year 1860. The poorer hill grazings of Scotland are also mentioned as an example of depletion which has been going on for the last 200 years. It is also pointed out in the memorandum that in the past there has not been a sufficient recognition of the fact that, accompanying the movements of animal products, there is a slow invisible flow of soil fertility.

The memorandum concludes—"Even though there is still so much more information urgently needed, the scientific information we already possess warrants the belief that the carrying capacity of pastures can be greatly increased, and the health and quality of animals grazing on poor pastures can be much improved. It is probable that the total production of the grazing lands of the world can be doubled, and this would mean an enormous increase in the primary necessities, that is, the world's real wealth. When, however, we are dealing with natural processes, where the cycle is completed only once in a year and the life cycle of the animal in several years, the experiments designed to yield the information which can be applied in practice require several years before the economic results are demonstrable. It is on these experiments, testing, and applying our acquired knowledge that the main research effort throughout the Empire is now being concentrated."

Empire Marketing Board Reports—Oranges, Agriculture, Pastures, &c.

Since the last reference to Empire Marketing Board publications was published in this *Journal* (vol. 2, No. 2, p. 122), six further reports have appeared. These are as follow:—

(*a*) *E.M.B. No.* 15, "*Oranges, World Production and Trade.*"—This publication, prepared by the Statistics and Intelligence Branch of the Board, is intended as a guide in estimating the future possibilities of the orange market, and includes a statistical survey of the production and consumption of oranges throughout the world.

(*b*) *E.M.B. No.* 16, "*Report on Development of Agriculture in British Honduras,*" by H. C. Sampson.—Mr. Sampson is an economic botanist on the staff of the Royal Botanic Gardens, Kew.

(*c*) *E.M.B. No.* 17, "*Schistosomiasis and Malaria in Relation to Agriculture,*" by J. F. C. Haslam.—This report was prepared for the Irrigation Sub-committee of the Committee of Civil Research. It is not an original contribution, but a compilation of information from existing literature.

(*d*) *E.M.B. No.* 18, "*The Composition of Pastures,*" by J. B. Orr.—In this report pastures are considered not as a crop but as a feeding stuff or raw material, and the most recently acquired knowledge of nutrition has been applied to problems connected with the feeding value of pastures.

(*e*) *E.M.B. No.* 19, *Empire Marketing Board, May,* 1928, *to May,* 1929, constitutes the third annual report of the Board.

(*f*) *E.M.B. No.* 20, "*Panama Disease of Bananas,*" by C. W. Wardlaw and L. P. McGuire. At the instance of the Empire Marketing Board, the authors have made a study of the causes which led to the abandonment of the plantations in the banana-producing countries of the Caribbean area.

The Library of the Science Museum, London.

The Director of the Science Museum, South Kensington, London, S.W.7, has asked that attention be drawn to the facilities for research workers provided by the science library at the Museum. The library possesses the largest collection of scientific and technical periodicals in Great Britain, and photostatic copies of any article can be prepared and supplied at a trifling cost. A comprehensive subject-matter index has recently been formed which contains references to articles and books on science and applied science which have appeared since 1902, and the library will send to any research worker a list of the articles which have appeared on any subject.

An information service covering the whole field of science and technology has been in process of organization at the Museum for some years, and recently the acquisition of a very large collection of subject-matter index cards relating to articles and books on pure and applied science published during the period 1902-1914, together with an almost equally large collection of bibliographical slips which only require to be mounted on cards to bring this index up to date, has placed the library in the possession of an exceptionally large card repertory which is now being arranged.

The library already contains more than 6,000 of the scientific and technical journals recorded in the "world list" of scientific periodicals published in the years 1900-1921, and together with the older series and those acquired subsequently, now possesses over 7,000 such periodicals which are being added to at about the rate of 1,000 periodicals annually. It also possesses a comprehensive subject-matter card index to papers in scientific and technical books and periodicals intended for use as a key to recorded information and for the supply of lists of papers on given subjects. This index, which will soon include about 1,250,000 cards, is classified according to the Brussels' extension of the Dewey decimal classification, so that all references to information on a given subject can be found in one place under a single classification number, and this number can be ascertained from the alphabetical index of subjects.

Bibliographies of special subjects are in course of preparation at very many institutions, but much of the labour expended in this work is only partially effective, because most of these bibliographies are classified on different systems, so that it is impossible to amalgamate them into a single index. To consult them many volumes and cards must be requisitioned, each different system of classification must be mastered, and then each side of each volume must be looked through separately.

There is, however, a considerable and increasing number of bibliographies, some of them very extensive, that are classified on a single system—the Brussels' extension of the Dewey decimal classification already mentioned—and as this system is the one which has been most widely used, and is the most convenient for indexing scientific literature on a large scale and in the greatest detail, it has been adopted in the library. This subject-matter index is still in course of preparation, but is now available to the public on application to the officer in charge of the reading room.

For those who are unable to visit the library, lists of books and papers will be typed from the cards so far as the general work of the library permits. Photostatic copies of articles can be furnished on repayment.

Recent and Forthcoming Publications of the Council.

Recent publications of the Council have been—

Bulletin No. 42.—"A Soil Survey of Block E (Renmark and Ral Ral (Chaffey) Irrigation Areas," by J. K. Taylor, B.A., M.Sc., and H. N. England, B.Sc.

Bulletin No. 43.—"The Bionomics of *Fasciola hepatica* in New South Wales and of the Intermediate Host *Limnea brazieri*," by I. Clunies Ross, D.V.Sc., and A. C. McKay, B.V.Sc.

Pamphlet No. 13.—"The Mechanical Analysis of Soils," by C. S. Piper, M.Sc., and H. G. Poole, M.Sc.

Publications which are now in the press or which will be issued shortly are as follow:—

Bulletin No. 44.—"Investigations on Spotted Wilt of Tomatoes," by G. K. Samuel, M.Sc., J. G. Bald, B.Agr.Sc., and H. A. Pittman, B.Agr.Sc.

Pamphlet No. 14.—"The Work of the Division of Economic Botany for the year 1927-28," by B. T. Dickson, B.A., Ph.D., Chief of the Division.

Pamphlet No. 15.—"The Work of the Division of Economic Entomology for the year 1927-28," by R. J. Tillyard, M.A., ScD., D.Sc., F.R.S.

Pamphlet No. 16.—"The Work of the Division of Animal Nutrition for the year 1928-29," by Professor T. Brailsford Robertson, Ph.D., D.Sc., Chief of the Division.

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